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ABSTRACT

Based on a literature survey of union cataloging, and New England libraries it was determined that: (1) New England's collective union catalog needs and problems had not been specified, especially regarding the possibilities of machine application; (2) crucial data and analysis needed for such specification was unavailable; and (3) the absence of this data prevented evaluations of relative merits of differing union catalog approaches and of different kinds of machine form catalogs. Three general union cataloging configurations were examined: (1) the single regional union catalog; (2) the combination of six state union catalogs; and (3) the random combination of state and/or interinstitutional union catalogs. Part II of this project was devoted to the development of the essential capabilities for a machine form union catalog of books and a printed union catalog of books for the New England Library Information Network (NELINET). This was accomplished by: (1) a study of machine form union catalog needs; (2) file design for present and projected needs; (3) development of techniques and programs for collecting, storing and updating library holdings data; and (4) development of programs to produce a printed union catalog using the Library of Congress card number as the identifying element. (Author/NH)

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FINAL REPORT

Project No. 9-0404
Grant No. OEG-0-9-310404-4438(095)

DEVELOPMENT OF A MACHINE FORM UNION CATALOG FOR THE NEW ENGLAND LIBRARY INFORMATION NETWORK (NELINET)

New England Board of Higher Education
20 Walnut Street
Wellesley, Massachusetts 02181

September 1970

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PART I UNION CATALOGING IN NEW ENGLAND: PAST, PRESENT, AND PROSPECTIVE: A PRELIMINARY SURVEY

by Samuel Goldstein

PART II SYSTEMS DESIGN AND PROGRAMMING

by Brent Byer, Douglas A. Campbell, Mary Jordan Coe, Ann T. Curran, Donald J. MacDonald, and William R. Nugent

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③ NEW ENGLAND BOARD OF HIGHER EDUCATION,
Wellesley, Mass~~achusetts 02181~~

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U. S. DEPARTMENT OF

HEALTH, EDUCATION, AND WELFARE

④ Office of Education (DHEW), Wash D.C,
RMQ66004 Bureau of Research

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INTRODUCTORY SECTION

SUMMARY

PART I:

The library literature on union cataloging and New England libraries was surveyed in an attempt to determine: (1) the extent to which New England's union catalog needs and problems had been, or could be, specified; (2) the extent to which union catalog activities within the region had been undertaken or proposed; and (3) the extent to which the union catalog capabilities of the New England Library Information Network's (NELINET's) automation project might be relevant to the resolution of all or some of the identifiable union catalog needs in New England.

On the basis of this survey, it was determined: (1) that New England's collective union catalog needs and problems had not been specified, particularly with respect to the possibilities of machine application; (2) that some of the crucial data and analysis requisite for such specification was unavailable; and (3) that, in the absence of such specification and data, unequivocal evaluations of the relative merits of differing union catalog approaches and of different kinds of machine form catalog (including NELINET's) had to be held in abeyance.

Within that context, three general union catalog configurations of possible relevance for the New England area were identified and examined: (1) the single regional union catalog; (2) the combination of six state union catalogs; and (3) the random combination of state and/or interinstitutional union catalogs.

There is no regional union catalog for New England, and although two state union catalogs do exist, both of these are card form catalogs. As it was concluded that none of the three configurations would be realized other than in machine form, and as there is no present regional plan for union catalog design and development, the third configuration is the one that is likeliest to be encountered in the immediate future.

On the basis of the analyses and findings made in this report, it is recommended that a region-wide survey of all aspects of union cataloging in New England, comparable to that which was undertaken for the nation as a whole by the American Library Association in the early 40's, but with particular attention being given to the interrelationships among machine form catalog, union catalog, and library network theories, be undertaken.

PART II:

The purpose of this part of this project has been to develop the essential capabilities for a machine form union catalog of books and a printed union catalog of books for the New England Library Information Network (NELINET). This has been accomplished by means of:

1. A study of machine form union catalog needs.
2. File design for both present and projected needs.
3. The development of techniques and programs for collecting, storing and updating library holdings data.
4. The development of programs to produce a printed union catalog in which the Library of Congress card number is used as the identifying element.

Access to a printed union catalog will be of immediate aid to students and scholars as well as librarians for inter-library loan and acquisitions. The machine form union list is a major step in NELINET's development and provides a basis for the future design of further capabilities: a Network library management information system, an automated inter-library loan system, a common circulation system, and an on-line retrieval system. The recommendations that conclude this report include the development of the above systems as well as research into the practicality and feasibility of including non-MARC data in the holdings file, intensified study of retrieval techniques by author, title, and subject information, and a study of terminals and query/response languages.

FINAL REPORT

Project No. 9-0404

Grant No. OEG-0-9-310404-4438(095)

DEVELOPMENT OF A MACHINE FORM UNION CATALOG FOR THE NEW ENGLAND LIBRARY INFORMATION NETWORK (NELINET)

PART I

UNION CATALOGING IN NEW ENGLAND: PAST, PRESENT, AND PROSPECTIVE; A PRELIMINARY SURVEY

by

Samuel Goldstein

New England Board of Higher Education
Wellesley, Massachusetts 02181

September 1970

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CHAPTER I: INTRODUCTION

In accordance with the requirements specified in *Preparing research reports for the U.S. Office of Education Bureau of Research, September 1968*, this chapter provides a summary of the investigator's report, background to the study, and other general preliminary considerations that may facilitate the reader's understanding of the subsequent discussion. Because the basis of the study was a standard literature survey, any methodological clarification that has been deemed necessary is provided in text or reference form at the appropriate points in the report.[1]

SECTION 1: SUMMARY

The library literature on union cataloging and New England libraries was surveyed in an attempt to determine: (1) the extent to which New England's union catalog needs and problems had been, or could be, specified; (2) the extent to which union catalog activities within the region had been undertaken or proposed; and (3) the extent to which the union catalog capabilities of the New England Library Information Network's (NELINET's) automation project might be relevant to the resolution of all or some of the identifiable union catalog needs in New England.

On the basis of this survey, it was determined: (1) that New England's collective union catalog needs and problems had not been specified, particularly with respect to the possibilities of machine application; (2) that some of the crucial data and analysis requisite for such specification was unavailable; and (3) that, in the absence of such specification and data, unequivocal evaluations of the relative merits of differing union catalog approaches and of different kinds of machine form catalog (including NELINET's) had to be held in abeyance.

Within that context, three general union catalog configurations of possible relevance for the New England area were identified and examined: (1) the single regional union catalog; (2) the combination of six state union catalogs; and (3) the random combination of state and/or interinstitutional union catalogs.

There is no regional union catalog for New England, and although two state union catalogs do exist, both of these are card form catalogs. As it was concluded that none of the three configurations would be realized other than in machine form, and as there is no present *regional* plan for union catalog design and development, the third configuration is the one that is likeliest to be encountered in the immediate future.

On the basis of the analyses and findings made in this report, it is recommended that a region-wide survey of all aspects of union cataloging in New England, comparable to that which was undertaken for the nation as a whole by the American Library Association in the early 40's, but with particular attention being given to the interrelationships among machine form catalog, union catalog, and library network theories, be undertaken.

SECTION 2: BACKGROUND TO THE STUDY

The New England Library Information Network (NELINET) is a group of libraries formally associated with each other for the advancement of their common interests through cooperative action. The charter members of the network are the main campus libraries of the six New England state universities, viz., the University of Connecticut at Storrs, the University of Maine at Orono, the University of Massachusetts at Amherst, the University of New Hampshire at Durham, the University of Rhode Island at Kingston, and the University of Vermont at Burlington. The various cooperative activities undertaken among the NELINET libraries are sponsored by the New England Board of Higher Education (NEBHE), an interstate agency specifically charged by its charter with the promotion of cooperation among the public and private institutions of higher education in the New England area.

The most innovative joint venture thus far undertaken has been an automation project which is attempting to establish a central file of machine readable bibliographic and local library data bases. These data bases, ultimately stored on random access media and processable by time-shared computers, will be capable of being remotely accessed by a large number of libraries to obtain a variety of technical processing and other library services.

The design philosophy underlying this NELINET automation project calls for the modular implementation of the envisaged total system in order that useful services may be provided for the participating libraries while the long range objective of building this central file and of utilizing its data bases is being accomplished. Accordingly, the first goal toward which the project was directed was the creation of a file of catalog data in machine readable form, and the first useful service to be provided from this file was the production of customized catalog cards and book spine and book pocket labels.

The technical implementation of these initial tasks, performed under a series of grants from the Council on Library Resources, Inc., has been detailed elsewhere.[2] As a result of this effort, a Library of Congress MARC II data for NELINET has been established, and a catalog card and label production system has been designed that (1) provides an operational simulation of the projected system and (2) that is capable of being utilized now by the participating libraries.

This card and label production system works in essentially the following manner:

1. The participating libraries prepare teletype requests for those products which they desire, and transmit these to the bibliographic data processing center;

2. At the center, the teletype requests are batched and run through a series of computer programs which search a magnetic tape master file of Library of Congress MARC II records;

3. For those requests corresponding to a bibliographic record in the MARC master file, a magnetic tape containing catalog card and book pocket label images, and a paper tape containing book spine label images, are produced;

4. The magnetic tape is run subsequently on a conventional IBM line printer to produce the appropriate catalog cards and book pocket labels, and the paper tape is printed out on a Dura tape typewriter to produce the requisite book spine labels;

5. The cards and labels are brought together in sets and mailed back to the requesting libraries.

As presently constituted, the local information supplied for each bibliographic title by the library at the time it requests products, e.g., the Library of Congress (LC) card number, the transaction or system number, the library identification symbol, any applicable branch or special location designation, any relevant copy or volume number, etc., is not retained or stored in the central file. The capability of inserting, collecting, and updating this local holdings information in the central file is essential if NELINET is to render its full range of contemplated services, including union cataloging, book catalog production, circulation and interlibrary loan control, etc.

It was to provide such capability, with particular reference to the union cataloging function, that the United States Office of Education awarded a grant of $97,180 to the New England Board of Higher Education on June 15, 1969. Although the technical implementation was to be subcontracted once again to the computer applications firm of Inforonics, Inc., of Maynard, Massachusetts, NEBHE agreed, as an integral part of this effort, to attempt to examine the relevance of NELINET's union catalog capabilities to the union catalog needs of New England. This examination was to be based primarily on a survey of the union catalog literature, supplemented as necessary by communications with, and visits to, existing union catalog activities in the region.

SECTION 3: GENERAL CONSIDERATIONS

Although the concept of the union catalog of books was known at least as early as the 15th century, the first great flowering of this bibliographic device in the United States took place during the 1930's, when a number of regional union catalogs were established. This efflorescence occurred, however, with little systematic reference to broader issues of library network and union catalog theory. As Merritt noted:

> "The growth of union catalogs in the United States resembles nothing so much as the now famous Topsy, who, innocent of all raising, 'just grew'. Union catalogs, too, have just grown--little or no attention has been given to the planning of their location; and their growth in size, function, and variety has gone on with so little serious attention from the library profession that it is today quite possible for five librarians to entertain five different and almost mutually exclusive connotations for the phrase 'union catalogs'."[3]

Today, almost 30 years later, the situation is still pretty much as that which Merritt described. Universally acceptable and unexceptionable definitions and classifications of union catalogs are not available; that this is so is due probably as much to the inherent difficulties of definition and classification as such, as it is to the inherent complexities of union cataloging theory and practice. Many contemporary discussions of, and plans or proposals for, the implementation of union catalogs in machine form continue to display minimal attention to larger issues of union catalog, machine form catalog, and library network theory and practice; that this is so is due probably more to human frailties and the operational constraints of actual library environments than it is to the substantive content of these fields.

A full exploration of the theory and practice of union catalogs (let alone of machine form catalogs and library networks) lies beyond the province of this study. It is hoped that the requisite amount of relevant exploration can be made at the appropriate points in the ensuing examination of union cataloging in New England. However, a certain amount of preliminary explication about union catalog definitions, classifications, characteristics, and functions is required.

PART A: UNION CATALOG TERMINOLOGY

The complexities of union catalog terminology have been explored by Merritt,[4] Brummel,[5] and Willemin.[6] Since the connotative differences mentioned by Merritt cannot be resolved, it becomes more essential that the sense in which one uses this terminology be made explicit than that there be general agreement about the 'correctness' of that sense. Accordingly, this section will try to indicate the explicit and admittedly arbitrary sense with which the present author will use specific terms.

'Union catalog' will be used as the generic term for an inventory, created and maintained essentially at a single location, of all or some of the publications owned by several libraries. Although actual union catalogs may inventory all forms of publications, e.g., monographs, periodicals, documents, etc., the present paper is concerned only with books and other monographs.

There are a number of ways by which union catalogs may be categorized, but the usual practice is to differentiate them in the first instance on the basis of the geographical distribution of the libraries that they inventory. Hence:

1. 'Regional union catalog', when used in a generic sense, with reference to the United States as a whole, will denote any union catalog that is based upon a definable geographical area, whether interstate, state, or municipal. When used with specific reference to the six state New England area, 'regional union catalog' will denote a union catalog of the libraries of all six states;

2. 'Interstate union catalog' will be used to denote a union catalog of the libraries of more than one, but less than all, of the New England states;

3. 'State union catalog' will be used to denote a union catalog of the libraries within any given New England state;

4. 'Municipal union catalog' will be used to denote a union catalog of the libraries within any particular New England metropolitan area.

As in the rest of the United States, a number of consortia, networks, and other cooperative groupings, formal or informal, of libraries within the New England area have been formed[7] or are likely to be formed in future. Although any group of libraries that are associated with two or more institutional or organizational entities are, of course, distributed through geographic space, most of these library groupings arise because of certain characteristics that the constituent libraries have in common, e.g., their type, their size, their proximity, etc., rather than because of their specific geographic location. In this paper, 'interinstitutional union catalog' will be used to denote a union catalog associated with a library group of this kind. Thus, if there were a union catalog of the NELINET libraries, which are dispersed throughout the six state region, or a union catalog of the Worcester Area Cooperating Librarians, whose libraries are located within a given municipal area, either one would be encompassed by the term, 'interinstitutional union catalog'.

PART B: THE FUNCTION OF THE UNION CATALOG

Merritt noted, with obvious disapproval, "the fact that the union catalog idea has up until now been considered merely a convenient device for locating books for interlibrary loan."[8] Twenty-four years later, Willemin was still able to categorically assert that "The main function of the union catalogue is unquestionably to locate publication in order to facilitate access to books. It is a tool for the rationalization of interlibrary loans ..."[9] This persistent tendency to think of the union catalog as primarily a location tool to facilitate interlibrary loan, which unquestionably has been its primary historical role, confuses union catalog practice with union catalog theory, and is, together with the practical constraints that have determined the historical structure and function of most union catalogs, one of the greatest inhibiting influences on contemporary thinking about the potentialities and limitations of union catalogs.

Willemin's assertion is better (and more realistically) paraphrased as "The main function of the union catalog is unquestionably to locate publications in order to facilitate physical access to books, and/or in order to facilitate access to information about the distribution of books." Furthermore, 'physical access' should be understood to be enhanced either through interlibrary loan, or, as is frequently the case, especially in heavily urbanized areas, through direct access, i.e., *in situ* reference to the located item at the holding location.

These restatements permit a more flexible analysis to be made of the elements of union catalog design. The theoretical characteristics of any given or proposed union catalog can be spelled out in terms of whether the objective of that catalog is (or should be) to facilitate physical access, information access, or both, and the actual characteristics of any given union catalog can be analyzed with respect to whether what is corresponds to what could (or what should) be.

For example, if one conceives of a union catalog solely as a means for facilitating physical access, and conceives of physical access solely in terms of interlibrary loan, then there is no point in listing books in the union catalog that cannot be loaned. "This same argument was instrumental in excluding reference works from the Nassau County union catalog."[10] But, if non-circulating materials can in fact be examined in situ at the holding library, their exclusion from the union catalog diminishes the extent to which that catalog actually can achieve its full potential, i.e., the facilitation of physical access.

Again, if a geographically based union catalog is conceived of as essentially a physical access facilitating device, and if this conception is coupled with the prevalent assumption that the union catalog is an instrument of research:

> "It is apparent that a very definite point of diminishing returns exists, after which the addition of more libraries to a union catalog will add very little to the catalog in terms of new titles not already represented. If the major objective of the union catalog is to locate as many different titles as possible without reference to the number of copies of each title that exist, it is important to realize that after a certain minimum number of libraries have been included, the new titles to be gained by adding another library are less than one per cent of the titles already recorded in the union catalog."[11]

On the other hand,

> "The very concept of a regional union catalog points to the desire to know what books are available within a limited geographical region, and for this reason alone it is important that all of the libraries in the region be included."[12] "... the decision to compile anything less than a complete record of the resources of a group of libraries must be made with full knowledge of the limitations the decision places upon the catalog ... a complete union catalog is the only adequate tool for the detailed study of regional library resources, the only adequate basis for a program of library specialization, and the fundamental implementation of a wide program of library cooperation."[13]

CHAPTER II: UNION CATALOG CONFIGURATIONS IN NEW ENGLAND

In New England, as elsewhere, actual and proposed union catalog systems may assume any of several configurations, but those which seem to be of particular significance are: (1) the regional union catalog, (2) the state union catalog, and (3) the interinstitutional catalog.

SECTION 1: THE REGIONAL UNION CATALOG

In 1940, the American Library Association undertook a nationwide survey of all aspects of union cataloging, one of the main objectives of which was the provision of data for determining viable geographic regions for union catalog establishment, and for coordinating such regional union catalogs with each other and with the national union catalog. The published report of that survey, Union catalogs in the United States,[14] and especially the portion of it contributed by L. C. Merritt,[15] remains the classic work in its field.

> "Mr. Merritt ... studied by statistical methods the resources of American libraries, the extent of duplication among libraries, holdings of foreign books, and other aspects of the situation ... His findings on the probable number of existing book titles in the United States and in the world are an important contribution to our knowledge of this subject ... Mr. Merritt ... also explored problems of regionalism as they relate to libraries and union catalogs, problems of union catalog compilation and maintenance costs, and problems involved in the theoretical achievement of an all-inclusive national union catalog."[16]

On the basis of his survey, Merritt postulated the existence of 16 'union catalog regions':

> "There is no magic in the number 16. It merely represents the number of regions evolved from a careful division of the country into areas that seem reasonable and logical units for supporting regional union catalogs. Particular boundaries between regions were determined partly by the existing boundaries of present regional union catalogs, partly according to spheres of metropolitan influence, and partly according to the convenience of state lines. This latter factor assumes much greater importance than it deserves, and it is probable that state lines should have been ignored in more than the four instances shown ... but convenience in counting library resources made it preferable to follow them whenever at all possible."[17]

The six New England states comprised one of these 16 regions and, although there were then three active union catalogs already within its boundaries, viz., the Union catalog of nonfiction in New Hampshire libraries (State Library, Concord, New Hampshire),[18] the Union catalog of Providence libraries (Brown University Library, Providence, Rhode Island),[19] and the Vermont state-wide union library catalog (Vermont Free Public Library Commission, Montpelier, Vermont),[20] Merritt observed that:

> "it seems preferable to locate the union catalog for the region in Boston, where it can be of immediate service to a larger number of libraries. Literally all roads in New England lead to Boston, and communication between this metropolitan center and all points in the region is fast and convenient."[21]

Merritt estimated that "A union catalog of the research libraries of the region, which contain 16,989,000 volumes, would cost $428,000 to compile. If the 38,010,000 volumes in all of the libraries were included, the union catalog would cost $958,000."[22] Tables 1 and 2, below,[23] provide a state by state breakdown of these estimates:

TABLE 1: A UNION CATALOG OF NEW ENGLAND'S RESEARCH LIBRARIES

	Volumes in Research Libraries in Thousands[24]			Costs in Thousands of Dollars[26]
State	Total	In existing Union Catalogs[25]	Net	
Maine	840	0	840	$ 21
New Hampshire	749	0	749	19
Vermont	333	333	0	0
Massachusetts	10,781	0	10,781	272
Rhode Island	1,282	0	1,282	32
Connecticut	3,337	0	3,337	84
TOTAL:	17,322	333	16,989	$ 428

TABLE 2: A UNION CATALOG OF ALL OF NEW ENGLAND'S LIBRARIES

	Volumes in All Libraries in Thousands[27]			Costs in Thousands of Dollars[26]
State	Total	In Existing Union Catalogs[25]	Net	
Maine	3,125	0	3,125	$ 79
New Hampshire	2,668	0	2,668	67
Vermont	1,730	1,080	650	16
Massachusetts	21,535	0	21,535	543
Rhode Island	2,602	0	2,602	66
Connecticut	7,430	0	7,430	187
TOTAL:	39,090	1,080	38,010	$ 958

As Brummel has pointed out, although "Merritt has gone very fully into the cost involved in the organization and maintenance of a union catalogue ... these figures date from 1942 [sic:?] and are therefore useless now. They may, however, be instructive on account of the various elements which form the basis of the calculations."[28] Unfortunately, a detailed analysis of those elements lies beyond the scope of this paper.

Whatever may have been its descriptive value, Union catalogs in the United States never enjoyed any presriptive success: regional union catalog development remained essentially a matter of unplanned local accident. The regional union catalog that Merritt proposed for the New England area never materialized, while the fortunes of the regional union catalog concept generally declined. It is perhaps more instructive for the purposes of this study to examine some of the probable reasons for that decline, since many of them still constitute important aspects of the operational setting within which the prospects for any regional union catalog development within New England must be evaluated.

The value of the union catalog has long been an article of faith with most librarians, but just how valuable a union catalog may be in comparision with other library priorities that compete for limited financial and human resources is another matter. The primary function of any union catalog is to indicate the location or locations of the items which it inventories; however, whereas the card catalog of an individual library indicates location by virtue of its in situ placement within that library, the requirement for location identification for several libraries in a single card catalog essentially calls for the creation of an entirely new catalog, and for on-going contribution to it by each of the libraries reporting to it. The costs attendant upon creating and maintaining union catalogs in addition to the individual local catalogs of the inventories libraries clearly have been of sufficient magnitude to weaken the priorities which librarians have in fact assigned to the development of such union catalogs.

Thus, even as Union catalogs in the United States was being compiled, the economic factors that had contributed to their proliferation, that is, the Depression, with its resulting unemployment and concomitant cheap labor pool, had come to an end. Although Merritt observed that, of the 17 regional union catalogs that existed in his day, "Ten regional union catalogs, including, the largest and most important, were compiled largely with labor furnished by the WPA ... The pattern is largely one of dependence on national and private funds for the construction of the union catalog ...,"[29] he incorrectly surmised that "There is no reason to expect this pattern to change materially in the development of a more complete system of regional union catalogs ..."[30] But, by 1948, Dewey was able to write:

> "Union catalogs may be said to have had their heyday in the 1930's during the period of availability of free labor from federal relief agencies. Few or no union catalogs were begun after the period of labor scarcity of the early 1940's set in. It is to be hoped that a revival of the 'union catalog spirit' will stem from more fortunate beginnings than another depression. However, it is difficult to see, during times of labor shortage, high clerical wage costs, and strained budgets, any other sources for funds with which to finance new union catalogs."[31]

Again, although Merritt optimistically claimed that "Even where regional union catalogs do not exist, indications of regional interest are apparent,"[32] that 'regional interest' was not translated subsequently into 'regional commitment' in New England and elsewhere. Furthermore, this failure of 'great expectations' cannot be attributed solely to the absence of an inexpensive labor pool, since the requirement for the latter is but a symptom of some of the more pervasive problems associated with union catalog creation and utilization.

In the first place, until comparatively recent times, Merritt and others were, of necessity, restricted to thinking about card form union catalogs, with all of the limitations inherent in the card medium. Not the least of these was the fact that, in order to minimize the scale of the task required to compile such a catalog in the first place, and the magnitude of the subsequent task of keeping it up to date, most such catalogs were restricted to a main entry arrangement. As a result, card form union catalogs were not only inherently special purpose catalogs created expressly to locate publications, but they were also essentially single purpose catalogs in that the information that they contained could be used, by and large, only to facilitate physical access to books.

On the other hand, many of the conditions which had led to the expressed need for, and proliferation of, regional union catalogs were to undergo significant changes in the period following the Second World War. These changes affected both direct and indirect access modes to library and research materials. Direct access to such materials was greatly enhanced by an education explosion and an emerging affluent society that manifested themselves in new libraries and in expanded library collections (albeit often at levels that do not measure up to extant quantitative standards for evaluating library collections), and by changing and innovative publications patterns, especially in the paperback, reprint, and microfilm fields, which made previously scarce research materials once more generally available (albeit not always inexpensively so). Indirect access via interlibrary loan was greatly facilitated as the result of federal and state legislation that stimulated the improvement of library service generally through the provision of bibliographic reference, teletype, and delivery support services, and as the result of the advent of the printed catalog or union list, most importantly the Library of Congress and National Union Catalog printed catalogs,[33] which made holdings information more generally and readily available than had ever been the case before.

All of these factors tended to weaken the priorities that could be attached to a special purpose catalog that was difficult and costly to create and maintain, and that was limited to a single purpose, the facilitation of physical access, which already was being served 'better than ever'. "Many critics have concluded that, in view of the limited use made of them, such catalogs are too expensive and too burdensome to maintain."[34] Nor, despite the existence of the Library of Congress and other printed catalogs, has the possibility of a printed regional union catalog offered much of a practical alternative to the card form version:

> "The printing of union catalogues [is, in general] viewed with disfavour because it is an enormously expensive undertaking; its advantage in saving time with book requests does not offset the costs of printing to the libraries. These costs are not limited to the printing itself, but apply also to the preliminary editing. This will be a time-consuming and expensive business, since cataloguing practice will often vary considerably in the participating libraries ... If, moreover, the printed catalogue is not to become obsolete within a relatively short time, it will have to be kept up to date by regular supplements, and this will mean a permanent burden."[35]

Finally, the theoretical values of the regional union catalog themselves have not remained unassailable with the passage of the years. A number of authors "consider the regional union catalog to overlap the National Union Catalog and, therefore, not to justify the expense required for their maintenance."[36] In 1948, R. E. Elsworth "maintained that the National Union Catalog, completed as far as possible, and with its material all brought up to the proper standard, would suffice as a national centre for information and loans. The regional union catalogues could then disappear ..."[37] Even R. B. Downs, the editor of *Union catalogs in the United States*, later came to express views that were implicitly inimical to the concept of the regional union catalog and, as Brummel observes, "it may be assumed that he, too, considers the importance of regional union catalogues after their inclusion in the Washington catalogue --and after the latter's publication in book form--as hardly sufficient to warrant their continuation."[38] Brummel himself, in defense of regional union catalogs, is compelled to comment that they are needed, "not only as a measure against inordinate growth of the National Union Catalog, but also because the latter has been selective in incorporating titles from other libraries, 'its objective having been to include entries for only the more important research materials in libraries the country over'."[39]

Nonetheless, the negative views of the utility of the regional union catalog may have received some quantitative measures of substantiation from M. K. Buckland, who, after observing that "It is curious that the fundamental wisdom of having a multiplicity of union catalogues should have remained almost entirely unquestioned through so much investigation,"[40] went on to make a comparison between multiple and single union catalog systems in terms of costs and performance, with frequent reference to the British system of multiple union catalogs. Using an optimized model of the present British system, and comparing it with a hypothetical alternative model consisting of a single union catalog, Buckland concluded that "To perpetuate the existing British multiple union catalogue system or to adopt any system involving more than one union catalogue would be to deliberately incur unnecessary cost, waste scarce skilled labour, and cause unjustifiable delays for readers."[41] Kuncaitis, although acknowledging that Buckland's evaluation is "well substantiated by calculations and may have meaning and value for Great Britain,"[42] implies that it has none for the United States when he adds that, "Yet, it seems that the size of a country and the special needs of a region are important factors in determining whether or not a regional union catalog should be established, continued, or dissolved."[43] Despite the rectitude of Kuncaitis' admonitions, it would perhaps be more helpful to union catalog planners if further investigation was undertaken to ascertain whether Buckland's data might not be more broadly applicable, as well as the extent to which his models hold for a machine form as distinct from a card form environment.

Merritt's was not the only substantial proposal for a New England regional union catalog of books. L. Schreiber, then Director of Libraries at Brandeis University (Waltham, Massachusetts), expressed the belief that:

> "It is feasible to establish a Regional Union Catalog for books fairly quickly and at relatively reasonable costs, servicing the six New England states by combining existing library tools and a computer memory. The existing tools are all those which give the LC card

number--Publishers' Weekly, Cumulative Book Index, and the Library of Congress catalogs of printed books (both authors and subjects). The LC card number itself would be fed into the machine to identify the specific title along with a simple locator for each individual library in the system. The use of an LC card number to identify a title eliminates the bottleneck and the cost of converting all the bibliographic data on the main entry into a form which the machine can read."[44]

Apart from the utilization of computer techniques and the specific application to the New England region, it should be pointed out that Schreiber's idea was conceptualized almost two decades before by H. Dewey.[45] It should also be pointed out that, while Dewey made no specific reference to the New England area, he did think that his system was applicable generally to any area that constituted a viable basis for a regional union catalog.

The heart of the Dewey-Schreiber approach is the use of the LC card number as the access point for location determination, and since LC card numbers are not assigned to all of the world's published output, the effect of this partial coverage on the function of the union catalog for assistance in interlibrary loan was a matter of concern to both authors. In a sample analyzed by Dewey

> "it was discovered that, of fifty-five requests for loans of separate monographs not in its collections received by the John Crerar Library in 1946 from libraries not having access to L.C. depository catalogs, forty-one, or 74.5 per cent, represented titles for which L.C. cards were available ... This is, of course, a small sampling; a competent statistical analysis of the requests received by one or more of the larger bibliographic centers is needed."[46]

In a similar connection, Schreiber noted that

> "a check of interlibrary loans for one year was made at four institutions with these results: At Brandeis University seventy-eight percent of books loaned had LC card numbers. At Boston College eighty-two percent of the books borrowed and ninety-two percent of the books lent had LC card numbers. At Wellesley College eighty percent of the books loaned had LC card numbers. While at Northeastern University eighty-nine percent of the books handled had LC card numbers."[47]

Schreiber, not without some justification, went on to observe that

> "These four instances may not be conclusive but they

certainly lend credibility to the assumption that the creation of a Regional Union Catalog based on LC card numbers would be worth developing. A tool which can expeditiously locate about eighty percent of our interlibrary loans is not a negligible addition to our resources."[48]

The essential operational components of the basic system envisaged by Schreiber were:

1. Member libraries would report their acquisitions to the center, by L.C. card number, or by author and title, if this is simpler for the library, leaving it to the center to locate the L.C. number;

2. At the center the numbers and locations would be fed into the computer memory;

3. Periodically the computer would generate listings by L.C. number, in numeric sequence, followed by the locations which have the book;

4. Should it be desirable, the center would also provide the numbers of titles not available in the area; or by ordering a sample card from the Library of Congress, lists of titles not available in the Region, as a guide for acquisitions;

5. The computer would also generate up-dated lists to be used at the center in answering phone or mail inquiries for books not covered in the last edition of the distributed catalog. If the desired title is located, the request for it could be forwarded directly to the owning library, thereby expediting receipt of the title by [the] borrowing library.[49]

Schreiber proposed a pilot project for a three year period and, although noting that "This pilot project should bring to light the problems that are involved in the actual operation of the system,"[50] he was, understandably, optimistic that this trial period would simply confirm the merit of his approach. Nonetheless, and notwithstanding the attractive appeal of some of the alleged advantages of the system, several aspects of Schreiber's proposal would appear to be somewhat ingenuous with respect to union catalog theory and practice.

For example, Schreiber suggests that "Input could begin with LC card numbers (titles) from 1950 to the present, primarily because The Library of Congress Subject Catalog started that year,"[51] and because "The span from 1950 to date should cover a major portion of contemporary research needs."[52] However, Schreiber does not actually adduce any data on the time distribution of the items requested on interlibrary loan at the four institutions, supra, nor any supportive data from comparable studies of time distribution in interlibrary loan, so it is not known whether he is still talking about 80%, or 40%, or 'what-percent-have-you' of LC card number effectiveness in interlibrary loan, and for how long that percentage will obtain. Thus, in the absence of such data, when schreiber asks, "Do we really have to wait until we can develop a technique to cover every eventuality, or should we accept an eighty percent level of effectiveness?"[53] one may reasonably inquire whether one is in fact dealing with an eighty percent level of effectiveness.

Again, as noted, although Schreiber asserts that the use of the LC card number to identify a title "eliminates the bottleneck and the cost of converting all the bibliographic data on the main entry into a form which the machine can read," the 'bottleneck' and 'cost' attendant upon obtaining the requisite LC card numbers, especially for retrospective materials to be included in the union catalog, is hardly explored. Schreiber proposes that the initial input data be obtained "by having the library shelf list microfilmed, using a portable fixed focus microfilming camera at the library,"[54] and keypunching the relevant (i.e., post-1949) LC card numbers at the center, but no details are given of the mechanics by which the relevant information is to be obtained, nor of the costs entailed in what would have to be a rather arduous and inefficient process (one would either have to cycle through the entire shelf list to determine which cards should be microfilmed, or cycle through a microfilm of the entire shelf list to determine which LC card numbers should be keypunched).

Finally, Schreiber proposed that "the nucleus of the Regional Union Catalog be established in the Boston Area, possibly at Brandeis, with the initial participation of the seven university libraries in this vicinity,"[55] and notes that his union catalog proposal "stems in part from a study which indicated that these libraries [viz., Brandeis University, Boston College, Boston University, M.I.T., Northeastern University, Tufts University, Wellesley College] duplicate such a small number of titles as to preclude any advantages from joint acquisitions or cataloging."[56] However, Schreiber goes on to note that, "As soon as the local nucleus is operative libraries geographically removed would be incorporated."[57] Since the computer memory to be used--an IBM Disk File--could store 200,000 LC card numbers at forty locations,[58]

> "The basic programs will be written to incorporate a possible total of forty libraries. The New England Region contains thirty-eight academic libraries which are adding approximately 5,000 or more volumes per year

> to their collections. The total number of volumes added for the year 1961-1962 is 753,269 taken from the Office of Education Report O.E. 15032-62. The additional programming effort to develop from a test group ... to all thirty-eight should be no more than ten percent."[59]

Given the inclusion in Schreiber's union catalog of the thirty-eight largest academic libraries in New England, one might well question whether the non-duplicative character of collections that precluded any advantages from joint acquisitions or cataloging, and that was partially responsible for justifying Schreiber's proposal in his own mind, would still be operative. For example, the six NELINET libraries would be included among the thirty-eight, and Nugent's study of collection overlap at the former institutions, "overlap data needed to predict the degree of joint use of cataloging information and to estimate the efficiency of collective reclassification, ... revealed a high degree of commonality in the six collections."[60]

Furthermore, it is a well known fact that many of these thirty-eight libraries (if not all), and certainly the largest of them (Harvard, Yale, Massachusetts Institute of Technology, Brown, Dartmouth, etc.) are precisely the libraries now reporting to the National Union Catalog. Some data would seem to be required to justify the duplicative kind of union cataloging reporting that would result if these institutions had to report to both the NUC and Schreiber's union catalog.

In view of the numerous inconsistencies in the Schreiber proposal, and the uncertain data adduced, it is difficult to ascertain the extent to which it could in fact meet the equally unspecified regional union catalog needs of New England. Clearly, Schreiber was proposing a union catalog of research libraries as opposed to all libraries; he believed that his system would eventually be able to inventory at least eighty libraries, and assumed that "libraries adding fewer than 5,000 volumes a year would not be included as input ... This figure would exclude most of the public and special libraries in New England from contributing to the input--but not from subscribing to the print-out and borrowing books for their patrons."[61] Furthermore, "since it is very simple to have the computer duplicate its memory, the New England Regional Union Catalog could exchange memories with other similar union catalogs so that a national network could readily be established."[62]

In the last analysis, however, Schreiber was still proposing a special purpose, single purpose union catalog (some additional purposes to which the catalog might be put also entailed seemingly cumbrous procedures), and since that catalog has its own functional and mechanical 'bottlenecks' vis-a-vis its compilation and utilization, it falls prey to the same general considerations relating to library priorities that have already been discussed in connection with Merritt's proposal. Since the main mechanical bottleneck still involves the problem of efficiently and inexpensively converting the requisite data from the individual library catalog to the union catalog, Schreiber's proposal might have been presented in a still more innovative fashion if it had been limited initally only to inventorying the current acquisitions of the contributing libraries. Such a limitation presupposes that the current acquisitions of today are the interlibrary grist of tomorrow, an assumption that requires further study of circulation patterns to determine at what point the requisite investment in the future might begin paying off, and still does not take into account more fundamental issues of union catalog theory.

It should be pointed out that, whereas Merritt cited no concrete New England examples of the 'apparent' regional interest that he detected for the creation of a regional union catalog, substantial indications of regional interest and involvement in Schreiber's union catalog existed (and possibly still exist). As has already been mentioned, numerous libraries participated in related study or planning activities, and it was expected that "if the necessary funds for the establishment of the Regional Union Catalog can be found, the project would be sponsored by the New England Library Association."[63]

The cornerstone of both Merritt's and Schreiber's proposals was the creation of a single union catalog serving the six state New England area. For reasons already given, however, such a regional union catalog does not exist, but the minutes of a meeting held within the past year of the Regional Planning Committee of the New England Library Association show the continuing interest of the New England library community in the concept:

> "... Charles Funk noted that preliminary experiments in Connecticut indicate that a computer-based union list or catalog might work for a large area such as New England if access were limited to computer query without print-outs ... Arlene Hope suggested that a feasibility study to explore this possibility might be supported by a grant under the Higher Education program, Title II-B which provides money for research in various fields and could be applied to a library project of this nature. Charles Funk moved that the incoming Chairman of this Committee consult with NELA Board for authority to have this committee, or a Sub-Committee, seek such a grant for a review of existing studies in this field and to prepare a suitable plan for a union catalog of books in

New England libraries. The motion was approved unanimously."[64]

That the substance of this motion be attained is devoutly to be wished. However,

> "It would be valid to state that for the most part union catalog sponsors have not been particularly concerned with the problem of fitting their catalogs into any kind of national plan ... If properly coordinated and developed, union catalogs can be an extremely valuable instrument for facilitating maximum use of each region's resources, and for stimulating the intelligent growth of these resources, but some guidance and direction from a national viewpoint would be highly desirable for the future development of these catalogs."[65]

It is hoped that such national leadership or national viewpoint may emanate from the efforts of the newly established National Commission on Libraries and Information Science. Whether or not that hope is realized, it is incumbent on any New England based regional union catalog study group to study first, no matter how hypothetical or abstract the effort may of necessity have to be, the relationship of New England's regional union catalog need to the national union catalog need.

Whether a regional union catalog for New England is actually needed, within or without a national context, and, if so, precisely what its character should be, or can be, and how and when it can be realized, these are matters which are probably not amenable to unequivocal or ready answers. However, at the very least it ought to be possible to establish certain guidelines for on-going or predictable developments within the region that have potential relevance to union cataloging, guidelines that will maximize the union cataloging potential of those developments for the region as a whole and that will minimize the possibility that such developments shall not have potential relevance to the region as a whole. If the proposed New England feasibility study were to accomplish nothing else, it will have accomplished a great deal.

SECTION 2: THE STATE UNION CATALOG

It is possible to conceive of New England's theoretical union catalog needs being met by six state union catalogs instead of by one regional union catalog, and mention has already been made of the existence of three such catalogs in Merritt's time.[66] Obviously, however, in order for the state union catalog approach to be able to satisfy the collective regional union catalog need, a state union catalog must exist for each of the six states.

In fact, however, that condition obtains for only New Hampshire and Vermont, the Union catalog of Providence libraries having been discontinued as of June 1969.[67] Although no state union catalog for Connecticut presently exists, there has long been active interest in that state for the creation of one, and a variety of proposals and efforts toward that end have been made and are contemplated in the future.

However, no active program for the development of a state union catalog for either Maine or Massachusetts (and now, Rhode Island) has been uncovered during the course of this survey. Kuncaitis notes that, "rather recently, a selective union catalog was established among Maine libraries, including cataloging and joint acquisition programs for public documents, interlibrary loan of books, etc.,"[68] but no other reference to this purported catalog has turned up, and two important library officials in Maine have no information about its existance.[69]

The one study of Maine libraries that dealt in any substantial way with union catalog matters, K. D. Metcalf's study of the larger libraries in the state,[70] although asserting that "a way can be found to provide one selective Union Catalogue which would include as much as 90 percent of the desired and really useful information ...,"[71] was quite negative about a general, i.e., comprehensive, union catalog:

> "One obvious way of making the desired information available would be to provide a Union Catalogue in each of the seven libraries [viz., Bates College, Lewiston; Colby College, Waterville; Bowdoin College, Brunswick; The University of Maine, Orono; the Bangor and Portland Public Libraries; and the Maine State Library at Augusta] for the holdings of all seven. But anyone who has had experience with the cost of establishing and keeping up to date inclusive Union Catalogues realizes that the cost would be far greater than the results would justify ... I do not recommend the formation of a complete Union Catalogue in each of the seven Maine libraries at this time or later. Nor do I recommend the formation of a single complete Union Catalogue for Maine libraries to be housed in any one of them, either at this time or later."[72]

The selective Union Catalogue that Metcalf recommended would include "(1) A complete Union List of current and back files of serials, periodicals and newspapers, bringing up to date the 21 year old Union List of Serials in Maine libraries ... (2) A Union List record of all holdings of microreproductions in each of the libraries, except those for single volumes or parts of volumes ... (3) A Union List of expensive research sets that, though important, are not used heavily and probably need not be represented by more than one or two copies in the State until holdings of material of this kind are considerably increased ... (4) A Union List of all publications before the year 1700, all American publications before 1801, and all rare individual volumes kept in rare book collections ... (5) A Union List of the holdings in each library relating to the State of Maine."[73] No program to implement Metcalf's recommendations is known, although active interest in them still exists.[74]

The major report dealing with union catalog possibilities in Massachusetts, that of Arthur D. Little, Inc.,[75] although proposing the creation of a State Library Service Center which "will maintain a union catalog of holdings throughout the state,"[76] conceived of that union catalog as primarily an inventory of public library and selective college, university, and special library holdings:

> "Because of the effort and expense involved in operating a union catalog, the largest college libraries will not be expected to contribute. Many of the resources of major college libraries can be located through the National Union Catalog. It would be most helpful, however, if the smaller schools and state colleges provided information on their holdings to the central information bank. This information would facilitate their own search for material and would help to shift the burden of interlibrary loan from the major resource libraries to the smaller, libraries, which now receive only a minor portion of ILL requests."[77]

Although the A. D. Little report has undergone substantial discussion and study in Massachusetts, its overall recommendations have not been implemented, nor is there any indication that such implementation is likely to occur in the immediate future. Nonetheless, the union catalog recommendation cited above is of interest in a number of ways.

In the first place, and unlike the indicated scope of the Schreiber catalog (page 17, above), it takes maximum advantage of the already existing National Union Catalog, and the contribution to it of the larger academic libraries in the state. Of course, it must be pointed out that the National Union Catalog is not invariably a satisfactory finding tool: as Schreiber has pointed out, "Despite [the existence of the NUC], any scholar or librarian who wishes to locate a title can attest to the frustrations involved and the lengthy delays. In the Metropolitan Boston Area, which is extremely rich in university libraries and book collections, there is no simple way of determining which library, if any, has a wanted title."[78] Nonetheless, whatever the shortcomings of the NUC may be, the exclusion of those libraries reporting to it from the proposed Massachusetts union catalog reflects another reality that Schreiber pointed to, i.e., "The very rich resources, [in the Metropolitan Boston Area] themselves preclude the possibility of establishing a Union Catalog with the usual procedures, because of the tremendous costs involved."[79]

Secondly, although the proposed Massachusetts union catalog is clearly geared toward the research function and toward facilitating interlibrary loan, it explicitly recognizes the potential value of a union catalog for distributing the interlibrary loan burden, a burden which the NUC, of necessity, tends to impose in ever greater degree on the few larger libraries of the region, e.g., Harvard and Yale. Of course, the mere existence of the requisite information in a union catalog is not a guarantee that such information will be used effectively. For example, in Vermont, which does have a state union catalog, one library, in a single year, "borrowed 94 items from Dartmouth and Harvard (neglecting to consult the Vermont Union Catalog) but 41 of these were subsequently found to be held by other Vermont libraries."[80] Apart from such human aberration, however, the actual utility of any union catalog for this 'distribution of ILL' function still depends on the character of the collections of the libraries that contribute to the union catalog, and the A. D. Little report does not provide sufficient detail on this score to permit any preliminary evaluation to be made.

There is little evident recent thrust for state union catalog creation in Rhode Island. This may be due in part to the fact that Rhode Island did have, until June 1969, a Union catalog of Providence libraries[19] to which the largest libraries in the state, i.e., those of Brown University, the University of Rhode Island, and the Providence Public Library, reported. However, the Providence union catalog had become highly selective over the years, both in terms of the number of libraries that were contributing to it,[67] and the categories of material that were being reported.[81] Now discontinued, it is no longer open to the public in any substantive sense.[67]

Whatever role the existence of the Providence union catalog may have played in fact in conditioning intrastate thinking about union catalog creation, no mention of it was made in Humphry's study of library cooperation in Rhode Island.[82] In fact, Humphry makes only two references at all to union cataloging in his study: the first, with reference to the Rhode Island Historical Society, recommends "that the Society work with librarians in all the libraries in the State toward the preparation of a union catalog of historical material;[83] the second, with reference to public libraries, proposes that "location of books and other union catalog functions"[84] be included among the services provided by the larger libraries. Humphry's first recommendation is reminiscent of one element of the selective union catalog that Metcalf proposed for the larger Maine libraries; his second recommendation would appear to be using 'union catalog' as an abstract term rather than as a specific physical entity.

In order for the multiple state union catalog approach to be able to satisfy some hypothesized collective regional need, it will be equally apparent that a state union catalog must not only exist for each of the states, but also that all of them must exist at the same point in time, at least within some reasonable span of time. Since there are no known plans at the present time for state union catalog creation in Maine, Massachusetts, and Rhode Island, and since there has been a temporary suspension of union catalog activity in Connecticut, it is obvious that the uniform development in time of the requisite number of state union catalogs has not only not occurred, but is unlikely to occur in the foreseeable future, unless some concerted regional impetus to the implementation of the concept is supplied.

However, as with the regional union catalog concept, the de facto historical and contemporary limitations on state union catalog development do not mean that, given an appropriate ordering of priorities and a means of implementation, and allowing for the effects of non-uniform implementation with respect to time, the multiple state union catalog approach to the resolution of New England's union catalog needs is incapable of realization. In fact, "Since the planning and development of regional union catalogs are usually accomplished on more or less local levels because of the greater ease of generating local support, it may frequently happen that catalogs will be organized for rather circumscribed areas, areas which would more logically be considered portions of a much larger region."[85] The active and inactive union catalog experiences in Connecticut, New Hampshire, Rhode Island, and Vermont represent tangible embodiments within New England of the greater probability of union catalog creation being undertaken on a comparatively lesser local level. It is necessary, then, to understand some of the practical and theoretical consequences of the state union catalog approach from the point of view of union catalog and library network theory. This understanding may perhaps be facilitated by an examination of some of the extant state union catalog situations in New England.

In practical terms, it would certainly be preferable for any given state to have a state union catalog rather than to have none at all. Nonetheless, if, as Purdy states, "librarianship rests (a little uncomfortably) on articles of faith, for example: instantaneous total access to the total record for everybody is a desirable social objective ...,"[86] the degree to which any given state union catalog can approximate that objective is in the first instance a function of the library resources available within the state.

The point can be made more clearly by reference to the situation in Vermont. The Vermont Union Catalog (VUC) was organized as a WPA project in 1940 under the supervision of the Free Public Library Commission, later the Free Public Library Service.[87] It has, as have so many of the WPA-sired union catalogs, had its vicissitudes over the years, but unlike some of the others it is still in existence (and rejuvenated existence), administered now by the Bibliographic and Reference Division of the new Vermont Department of Libraries.[88]

The VUC takes an exceptionally liberal point of view about the inclusion of libraries in its inventory. In fact, H. O. Marcy 4th, prior to assuming his present position as Director of the Bibliographic and Reference Division, had recommended that "Every conceivable type of library; including public, school, academic, and special (of all varieties, especially governmental); should be COMPREHENSIVELY represented in contributions to the VUC ...,"[89] and this recommendation is now definitely in force.[90] Furthermore, not only every type of library, but all of the libraries of every type, are encompassed by this policy.

Thus, it is theoretically possible that the VUC could become an inventory of the total library resources within the state of Vermont. The essential element, then, with respect to the 'total record' concept, is the depth of the state's library resources.

Although one survey of library service in Vermont observed that, "Considered as a whole, Vermont has book resources adequate in numbers (though not necessarily in quality) to serve the library needs of its citizens,"[91] it is difficult to ascertain on what grounds such a conclusion was reached, especially in comparison with the research materials available in the other New England states. What would appear to be a more realistic appraisal has been given by Parker:

> "It is obvious that institutions within Vermont do not have enough library resources to meet the demands of the faculties and students now working in the State. In 1966 the total of books held in the State by the State Library, the Free Public Library Service, the seventeen academic institutions and the eight museum and industrial libraries amounted to 1,599,000 volumes. In the State of Connecticut for example just the aca-

> demic institutions held 8,374,736 volumes. It is also apparent from the inter-library loan requests made by the libraries studied that there are not sufficient books at hand."[92]

Clearly, then, at present resource levels, everybody in Vermont automatically has 'less access' to 'less record' than the citizens of some of the other New England states have within their own state boundaries. The essential point is that, regardless of how good a job the VUC can do as an inventory of the state's library resources, Vermont residents have a vested interest in the furtherance of union catalog development throughout New England, insofar as regional union catalog capabilities can enhance utilization of regional library resources.

Whether that vested interest is worth the investment of Vermont money for regional union catalog purposes, however, is once again a matter of priorities based on comparative value received. Parker stated some of the options and, implicitly, some of the operative value judgments, when he observed that, in order

> "to extend book resources beyond normal budgeted purchases, the college librarian can borrow books, buy books cooperatively, or try to secure additional funds by gift or grant. Inter-library loan can be utilized to a limited extent for specific titles but does not satisfy the essential need on campus for sufficient books to support undergraduate courses. Nor can the out-of-state loan system supply the greater resources in scope and depth required by honors programs and graduate offerings."[93]

In New Hampshire, the union catalog, now serviced by the Reference and Loan Division of the New Hampshire State Library,

> "was started in 1938, to locate current nonfiction requested on loan from the State Library. As lack of means prevented a thorough inventorying of the entire resources of the cooperating libraries, it was decided to contribute cards only for nonfiction purchased by the libraries after January 1, 1938. This chronological division, however, does not now hold entirely true, since duplicate cards have been received and filed from the American Imprints Inventory of the state."[94]

Unlike Vermont, where all of the state's libraries are either contributors to the state union catalog, or are considered to be potential contributors, only thirty-six of New Hampshire's libraries contribute to the state union catalog: "3 state colleges and university libraries, 1 state technical institute, 10 private college libraries, 2 prep schools, and 20 public libraries."[95] Among the important libraries within the state that do not contribute to the union catalog is the Dartmouth College library, the largest in the state. Furthermore, one gets the impression that, even if Dartmouth's contribution were desirable and possible, the State Library presently lacks the means for absorbing the increase in union catalog volume that would result.[96]

More importantly, there is every indication that interlibrary loan is working out quite well in New Hampshire, even though the state union catalog is only a partial inventory of the state's library resources. "Borrowing, of course, is not limited to libraries in the union catalog ... For example, Dartmouth College general and medical libraries, Sanders Associates Technical Library and the several specialized collections of New Hampshire state departments are also a generous source of books and periodicals, otherwise not easily obtainable."[97] As in Vermont, "Libraries outside the State are approached when the National Union Catalog ... or other sources indicate that they own a particular item."[98]

The supportive bibliographic apparatus at the State Library, the availability of a bibliographic 'locating' guide,[99] flexible interlibrary loan arrangements among New Hampshire's libraries, and the use of teletype to speed requests within the state, all have combined to expand and improve interlibrary loan service in New Hampshire. "Although this interlibrary loan service costs over $11,000 a year, as long as a resident of even the smallest town in New Hampshire can easily obtain a book from the largest library in the country we consider this expenditure an investment in progress."[100]

Nonetheless, it may be reasonably assumed that the absence of a complete union catalog in New Hampshire does reduce the actual effectiveness of interlibrary loan mechanics within the state, in relative terms, at least, since it is still necessary to 'cycle' some requests among a number of locations before a definitive determination of the holdings situation can be made. And yet, it may well be argued whether that reduction in effectiveness is substantial enough to warrant the cost of creating and maintaining a complete union catalog, when something over $11,000 a year seems to be yielding a high level of felt satisfaction with the present interlibrary loan service. When Merritt calculated the cost of union catalog creation for the New England region, he estimated that the cost for New Hampshire would be $67,000 for a union catalog of all volumes of all libraries, and $19,000 for a union catalog of all volumes in research libraries only (see Tables 1 and 2, page 9). (Merritt omitted the volumes then in the New Hampshire union catalog from consideration "because none of the libraries are completely represented, making it necessary to copy the entire catalogs of these libraries if a complete union catalog were contemplated."[101]) Of course, Merritt's figures reflect obsolete data as to prices, collection sizes, methodologies, etc., and one can only speculate that the 1970 costs of creating a complete union catalog in New Hampshire would eat up a lot of $11,000 per year years.

New Hampshire's residents are also faced with the same problem that confronts those of Vermont, that is, the comparative limitations of the library resources available within the state. Although New Hampshire is in somewhat better condition than Vermont in this respect, thanks in large measure to the existence within its boundaries of the extensive collections of the Dartmouth College Library, its intrastate research materials base is still appreciably smaller than those which are available in the states of Connecticut and Massachusetts.[102]

Finally, the different levels of inclusiveness of the New Hampshire and Vermont union catalogs point up another problem of the multiple array of state union catalogs in meeting the collective regional need, especially when the latter has not been specified and the former have been independently developed: that is, the extent to which such state union catalogs may be functionally compatible with each other. Since the VUC covers, or at least seeks to cover, all of the libraries within the state, its data base theoretically could be used to facilitate either physical access to books or access to information about the distribution of book resources within the state. The New Hampshire Union Catalog, on the other hand, being only a partial inventory of the state's libraries, can have little inherent application beyond facilitating physical access to library materials.

In that connection, it should be pointed out that the use of a union catalog to provide access to information about the distribution of library resources is itself affected by the type of library materials included in, or excluded from, the union catalog. In this respect, the differences between the New Hampshire and Vermont catalogs are much less pronounced, the VUC being primarily, although not exclusively, an inventory of "(1) all non-fiction titles and (2) selected fiction (Vermont authors)."[103] Thus, even the VUC could not be used as a direct measure of the distribution of all of the library resources within the state.

Nor are the effects of excluding fiction and juvenile materials from a union catalog necessarily limited to that catalog's capability of providing access to information about the distribution of materials. Merritt saw such exclusion in terms of their possible deleterious effects upon the research character itself of a union catalog:

> "Although the initial saving involved in excluding certain classes of material from the union catalog may be small, it may in some cases be necessary if the union catalog is to be compiled at all ... Insofar as it is considered more important to locate nonfiction than fiction, there can be little quarrel with excluding fiction from the catalog. And so also with other special classes of material. But it must be remembered that research is not apt to respect arbitrary lines drawn by librarians, and that the success of the union catalog depends on its ability and willingness to answer all requests and meet all demands, irrespective of their research character, or their evident seriousness."[104]

The two extant state union catalogs in New England are card form catalogs. Such card form union catalogs can grow to enormous size while still retaining comparatively great utility--witness the National Union Catalog, itself, or the Union Library Catalogue of Pennsylvania--but, nonetheless, the card form catalog presents a host of problems inimical to the creation, maintenance, and utilization of union catalogs. It has already been noted (page 11, above) that problems of creation and maintenance have restricted most union catalogs in arrangement to main entry and in function to facilitating interlibrary loan. Even here, however, the utilization difficulties require an extensive bibliographic support apparatus, or the development of alternative bibliographic tools.

For example, Marcy notes that:

> "The VUC, as is typical of union catalogs [sic: in card form] generally, is a main entry catalog. There is no attempt to provide title added entries, subject headings or, even, author added entries. The implications are clear. The main entry of a requested item must be known with reasonable assurance. And, a search for materials relevant to a particular subject is virtually impossible. Obviously, any number of appropriate reference tools may be used to acquire knowledge of the main entries of relevant items prior to using the VUC ... Computerization of the VUC at some point in the future would have the advantage of greatly increasing the number of possible search strategies. At present, the only basic search strategy possible is the sole main entry approach. This is a severe limitation of the VUC."[105]

Marcy goes on to recommend that:

> "Until such time that the VUC is computerized, subject searches ... should be aided through a greatly expanded union list of special collections in libraries in Vermont, to be compiled and maintained on the basis of a systematic study of subject specializations in the libraries in the state ..."[106]

Such 'union lists' of special subject resources or collections already exist in printed form in New Hampshire,[99] Maine,[107] Rhode Island,[108] and Connecticut,[109] and are under discussion for at least a portion of Massachusetts.[110] The introduction to the Connecticut list is of particular interest with respect to the way in which it relates the list to the union catalog situation:

> "On many occasions, librarians in Connecticut have expressed a desire for a union catalog of the libraries within the State. There is little dissension to the opinion that one would be highly desirable and useful. There are two drawbacks: first, it would be tremendously expensive to prepare (estimates have ranged from one-half to ten million dollars or even more, depending on the numbers and sizes of the libraries to be included and the method of preparation); second, it would almost certainly take years to complete. Neither of these drawbacks rules out the possibility that a union catalog for Connecticut may not someday become a reality, but they do emphasize that it will not in the near future. Meanwhile, some means better than sheer guesswork is necessary to help Connecticut librarians find needed information and publications for their patrons. The Directory of Subject Strengths in Connecticut Libraries is an attempt to meet that need."[111]

In view of the problems associated with card form catalogs, the possibility of utilizing machine readable media in lieu of cards for union catalog purposes has long held attraction for the library community.[112] However, the use of such machine readable media, coupled with the availability of large data bases such as will emanate from the MARC and RECON efforts of the Library of Congress, introduces a whole new set of variables into the 'union catalog environment'. While most of these will be explored at some length when NELINET's relevance to New England's union catalog needs is discussed, some of them may be highlighted by an examination of those proposals and efforts thus far made to automate state union catalogs in New England.

Arthur D. Little, Inc. (ADL) recommended the computerization of the New Hampshire Union Catalog:

> "Although the present level of use of the Union Catalog may be within workable limits, New Hampshire can expect

> substantial increases during the next several years, both in the number of books held within the state and in the amount of ILL use. The present manual catalog will soon be strained beyond capacity. The State Library should plan to automate now before a crisis situation develops. In this way, service will be uninterrupted and will soon be speeded to suit the needs of modern New Hampshire."[113]

ADL also recommends computerization of the VUC:

> "The Union Catalog is the greatest single asset of the Free Public Library Service. Every effort should be made to preserve and improve the accessibility of this resource to librarians throughout the state. While improved manual procedures should bring about a significant improvement in the usefulness of interlibrary loan over the near term, in the long run converting the Union Catalog to a machine-readable format holds promise of providing a real breakthrough. We recommend therefore that planning be begun now for eventual computerization of the Union Catalog and its subsequent publication in book form for distribution to all librarians participating in the ILL system. When available, such a book catalog will reduce the time required for most interlibrary loans to from 48 to 24 hours."[114]

A fair evaluation of the ADL proposals for New Hampshire and Vermont would require extensive analysis and evaluation that cannot be provided here; it is in that context that the present investigator admits to some confusion in interpreting certain elements of those proposals. For example, one wonders whether the ADL analysis of the use of magnetic tape as the machine-readable medium for New Hampshire may not be somewhat naive vis-a-vis the potentials of magnetic tape for union catalog purposes:

> "Transferral of the Union Catalog from cards to machine readable tape will require an expenditure to [sic: ?] time and money, but we feel that the long-term benefits will warrant the expense. Computer tapes can store great quantities of information in very little space. They are capable of continual updating, and searching can be done automatically ..."[115]

In fact, updating and searching of magnetic tape files, especially as they grow larger in size, is neither automatic nor efficient. Insofar as 'real-time' reduction of ILL delays is concerned, magnetic tape is simply not a viable medium, nor is its use for subject-oriented literature searching, as ADL also suggests, really optimum in a large file environment. More factually, ADL goes on to state that "Computerization [assumedly still using magnetic tapes] will further allow for a rapid printout in book form, which may be useful for the large libraries."[116] Why such a printout should be useful for the large libraries as distinct from the smaller libraries is difficult to understand, since, as Merritt pointed out, "In general ... it is possible to say that the larger a library is in terms of the volumes it holds, the more apt it is to include the holdings of other libraries, and the more apt it is to own works that other libraries have not acquired."[117]

In the case of Vermont, ADL notes that, "With the development of real-time (i.e., immediately responsive) computer systems, there is no technical barrier to complete automation of the Union Catalog in Montpelier."[118] But 'real-time' has to do with the access modes to the system, and has nothing to do directly with the fundamental problem involved in converting existing files. As ADL itself almost immediately thereafter noted, "In an automated system, each entry--whether by author, title, or subject--in the Union Catalog [sic: in Vermont, the vast majority of inventoried material is author entry] would have to be converted to machine readable form and then stored on magnetic tape or disc,"[119] and the technical barrier, that is, the bibliographic, methodological, and cost problems, associated with this conversion still exist.

In Vermont, ADL is clearly talking about a 'real-time', on-line union catalog, at least for the major libraries in the state:

> "Eventually ... it would be possible to install a remote teletype console in each major Vermont library ... Then, librarians desiring ILL information would merely dial a Montpelier telephone number, type author or title heading into the machine, and receive a near instantaneous listing of the libraries holding the desired title."[120]

For the smaller libraries of the state, a book catalog would be provided, with author, title, and subject headings, listing all of the books in libraries statewide. In this case, "A printed catalog would be of great utility to smaller libraries where the installation of a remote console could not be justified."[121]

Both ADL reports show an awareness of the emerging issues and problems of the new 'union catalog environment', but fail to pursue them to their logical conclusions, and fail to explore them in depth. In each case, an awareness of the potential relationship between a state's centralized processing or cataloging activities and its union catalog activities is made explicit, but the union catalog function is a priori assumed to require separate implementation, and the possibilities of an 'integrated' automated catalog capable of serving a number of functions, union cataloging included, are not explored. In each case, the desirability of the one state sharing union catalog 'computerization' costs with the other is stated, but (1) without regard to the different characteristics of the existing card form union catalogs in each state, and, hence, the possibly different conversion requirements, (2) without reconciling the disc/tape differentials previously noted, and, hence, the possibly different utilization requirements, and, occasionally, (3) without realistic reference to areas of true savings through cost sharing as, for example, when it is suggested that "New Hampshire and Vermont might well wish to share the cost of procuring MARC tapes,"[122] a trivial savings in the light of the annual subscription cost (now $800) of the MARC tapes and in view of the comparatively enormous costs of actually processing those MARC tapes. Interestingly enough, ADL never suggested the possibility of creating an interstate union catalog inventorying the library holdings of New Hampshire and Vermont in a single catalog.

H. O. Marcy 4th has been kind enough to indicate the official present status of automation discussions relating to the VUC:

> "My report of March 1969[123] refers to the possibility in the future of converting the Vermont Union Catalog to machine readable and manipulatable form. At present there is no plan to undertake this conversion. Also, although we have considered dividing the union catalog (in the sense of manual for the past and machine readable for the future) we have not even discussed a possible date for starting this. The Department of Libraries has not been involved in the use of data processing equipment or computers in any respect. Consequently, it is difficult to consider realistically or to consider as practical the conversion of a (to us) relatively large mass of data (in the VUC) to machine readable form. We have devoted more serious thought to beginning our use of data processing equipment and/or computers to something much simpler such as the production of a Vermont Library Directory with continual updating, or the development of a Directory of Vermont Newspaper Holdings within the State of Vermont, or a Vermont Union List of Serials ... The usual problems--time, money, expertise--have prevented us from accomplishing anything in this whole area."[90]

Two points in Mr. Marcy's communication deserve some comment. In the first place, however trite it may seem to stress the point, the existence of computers, of machine readable media, and of glamorous predictions about their utility, do not alter the hard facts of the real library world: it is still extremely difficult, from economic, human, bibliographic, and technical reasons, to implement a union catalog in machine form. Secondly, since one of the major stumbling blocks to that implementation continues to be the conversion of existing catalog data to machine readable form, since the elimination of that bottleneck probably requires the successful implementation of the Library of Congress RECON project[124] and/or the development of automatic format recognition techniques, since the latter requirements will take some years before their effects are felt, and since the Library of Congress MARC tape distribution service may be an inexpensive source of input into a machine form union catalog for current imprint monographic materials, the possibility of dividing the VUC in the manner Marcy noted deserves further study, not only in Vermont, but wherever union catalog creation is of concern. The possibility of creating a union catalog from a current date forward has already been mentioned in this paper, in connection with the Schreiber catalog (page 18, above), and will not be pursued further at this point.

"There is widespread agreement on the need for a locating service in Connecticut,"[125] and the creation of a state union catalog is supported by the Connecticut Library Association at the highest priority level:

> "... in the Fall of 1965, just after the legislative shift that re-oriented the direction of the State Library, the CLA Fall Regional Meetings were devoted to a series of skull sessions aimed at finding out what the librarians of the state were looking for from the State Library. One item frequently mentioned was the desirability of a union catalog ... in the Spring of 1968, the CLA Development Committee issued a report[126] listing, on pages 9 & 10, sixteen items labelled 'Some cooperative projects needing discussion as to their relative merits.' One of these was 'Current and retrospective union catalogs.' Almost immediately upon the issuing of this report, CLA formed a Legislative Committee to consider the report and to recommend legislation to be introduced at the 1969 session of the General Assembly that could begin to implement the recommendations. That committee considered the sixteen items and agreed that items numbered 2, 3, 4, 10, 11, and 16 (but with the feeling that 10 and 11 were really just one item) should, collectively, be considered as the Number One priority. The union catalog is item no. 3 of these. The committee recommended that the State Library should include, in its budget request for the 1969-70 biennium, funds for this purpose, which was done but which failed. Most recently, in November of 1969, the then CLA Development Committee (of wholly different membership than the one that issued the above

> referred report), which was also sitting at the time as the Legislative Committee, opined, 'The committee does not, at this time, recommend any major revision of those priorities on record by earlier committees. It suggests the continued need for a union catalog and those state wide services - as stated above - now in effect.' (Report of meeting of Nov. 21, 1969 - dated 12-2-69.) This does seem to be a clear mandate that CLA supports a union catalog."[127]

In view of this widespread interest and support, it is not surprising that a number of articles and papers deal in whole or in part with the creation of a state union catalog in Connecticut. It is equally not surprising that these accounts differ somewhat with respect to the precise character of the union catalog being sought, and to the mechanics by which it might be brought into being, although there does seem to be a general emphasis on a union catalog that is essentially an instrument in support of research. A detailed analysis of the Connecticut situation is again not possible to undertake within the present study, but certain aspects are of particular inferential relevance.

The United Aircraft Corporate Systems Center (UACSC) _Initial report on a study to plan development and implementation of a Connecticut library research center,_[128] although its recommendations have not been put into effect, is deserving of particular attention. In the first place, although it deals with the creation of a special purpose union catalog, that catalog is possessed of a number of functional capabilities. In many technical and functional respects, the Connecticut Library Research Center proposed by UACSC and the center that would result from the NELINET automation project are alike or similar, although in the Connecticut case "Locating and searching will be the primary functions of the Center,"[129] while the NELINET Center will be concerned primarily with the provision of technical processing services in support of cataloging and acquisitions; the 'secondary' functions of each, however, embrace significant portions of the other's primary functions (for example, the Connecticut Center proposed to offer (1) printed products, e.g., book catalogs, acquisition lists and current awareness lists by subject, and (2) central coordination of cataloging and dissemination of catalog data to libraries, and the NELINET Center will offer union cataloging and bibliographic searching services). In view of this similarity, most discussion of technical aspects of the UACSC proposal will be made in the course of discussing NELINET's relevance to New England's union catalog needs. However, it is clear that, if the feasibility study proposed by the NELA Regional Planning Committee (page 18, above) is ever undertaken, the review of existing studies that it calls for will require the careful scrutiny and comparison of the UACSC and NELINET approaches.

Secondly, the UACSC report discusses the proposed Center repeatedly within contexts that are particularly relevant to the application of machine form catalogs in actual library environments. For example:

> "The relationships between various library activities at the state level should be kept in mind. The primary purpose in establishing a State Library Research Center in Connecticut is to make a knowledge of the informational resources of the State readily and rapidly available to all who may need them, and in particular to those engaged in research activities. Closely related to this objective are other objectives being planned by the State Library. Where automation is being contemplated in one activity, namely the Research Center, full advantage should be taken of the availability of this capability in the provision of other library services. The centralized control of bibliographic processing is a prime example, particularly in view of the fact that cataloging data represent a necessary input for the functioning of the Research Center ... in the interests of optimum service and greatest economy of human and financial resources, coordination of planning effort is essential, and the extent to which central facilities may be shared should be investifated as the State Library Service program progresses. It is clear that the Research Center and the other services proposed are closely related and complement each other."[130]

Although the General Assembly decided not to appropriate funds for the proposed Connecticut library research center, the Connecticut State Library subsequently has undertaken a centralized cataloging program and a machine form union catalog input program,[131] both of which, somewhat ironically, in the light of the above UACSC advice, seem to be independent of each other with respect to the machine formats that they employ, and neither of which, at any rate, is directly compatible with the MARC format of the Library of Congress. Although the possibility of future integration of the two state programs has been explored, and although a 'high degree of MARC-compatibility is assumed',[132] some doubts may arise in the outside observer, if only with respect to the possibility of conversion and communications problems that may arise in future. For example, in the union catalog input program, the LC card number was not encoded (for a number of reasons[133]), but the LC card number is a key data element of the MARC and RECON formats, and its exclusion has direct implications for the modes by which Connecticut might utilize such data bases in future.

A particular irony of the Connecticut State Library's machine form union catalog input program, begun in November, 1968, relates to Dewey's hope that the revival of the 'union catalog spirit' would stem from more fortunate circumstances than the kind implicit in the Depression of the 30's (page 11, above):

> "The State of Connecticut has found a promising low-cost source of the clerical labor needed to produce a union catalog of the book holdings of the State's many libraries: the inmates of the Women's Prison Farm at Niantic. And the result would seem to be a happy one for all concerned: libraries will get their union catalog, the prisoners will get valuable vocational training--plus wages which are somewhat better than the standard 25 cents a day received by prisoners-- and Connecticut industry will get a crop of skilled operators of ABM [sic: IBM] Datatext equipment--after the operators get out of the pokey. The Connecticut union catalog project starts with reproduction on microfilm of the shelf list of a given library. This is then sent to Niantic, where a Datatext operator, suitably trained and working under the full-time supervision of a librarian, turns the shelf list copy into machine-readable paper tape. Each operator has her own microfilm reader to work from. The Connecticut program was set up as part of the State's education and rehabilitation program for prison inmates."[134]

The Connecticut program, or at least the first phase of it, was actually made possible when the State Library Committee of Connecticut committed "Library Services and Construction Act funds to a five-year, $500,000 program aimed at producing a computerized union catalog of the holdings of the state's public libraries."[135] Unfortunately, the program had to be discontinued in August 1969 because of (1) operator problems, (2) IBM Datatext problems, and (3) a reduction of LSCA funds.[136] It is also unfortunate that no account of Connecticut's experiences during this period is available in the library literature, since some of those experiences may have broader applicability. For example, one of the reasons that the LC card number was not encoded[133] was that it appears in such miniscule type on older LC cards that it is not legible, at least readily, on a microfilm viewing screen.[137]

The UACSC report also took the commendably broad view of the automation activities that might take place in Connecticut in the context of those that might take place in the nation as a whole:

> "... it is to be expected that, sometime in the future, the automated State Center will become a component of a

> national library system ... In this respect, coordination with planning at the national level is important ..."[138]

However, and again one is compelled to use the word 'ironically', no mention is made in the UACSC report of the possibility that the Connecticut State Center also may logically 'become' a component of a regional library system, or that coordination with planning at the regional, i.e., New England, level may be of almost equal importance. Certainly the latter is at least of first order importance over the coming years. Coordinated planning with the other New England states, and at least a minimal thrust for developing guidelines and standards, where possible, is essential, not only for the good of the region, but for the good of the library components within Connecticut itself.

Consider, for example, the University of Connecticut, an academic library with both intrastate and extrastate relationships. The University of Connecticut Library is one of the charter members of NELINET, having formal relationships with the five other New England state universities, as well as with any other future members of that particular library network. The University of Connecticut Library is also a member of the Association of Research Libraries, an association of the largest libraries in the United States which is almost certain to undertake or be pivotal in future library automation developments. The University of Connecticut is also part of the so-called CTUW-Y project within Connecticut; this project, which involves the University Library with those of Connecticut College, Trinity College, Wesleyan University, and Yale University (as well as with the State Library), is now primarily a teletype (TWP) based interlibrary loan network, but it might evolve in future into more advanced automation-based cooperative activities. And the University of Connecticut Library is also, after Yale, the largest research library in the state of Connecticut, and as such a valuable resource to the state. Thus, the University of Connecticut is involved in at least four organizational or geographical relationships, each of which may in future entail involvement with automation and machine form data bases. Although one cannot know with precision what those involvements may be, enough is known about the cost and functional consequences of having to run parallel machine systems, or input into different systems in different ways. As Merritt stated the problem for union cataloging, "a library's inclusion in a regional union catalog implies an obligation to contribute to that catalog ... for its accessions. This obligation is not particularly hard to meet when contribution is made to only one regional catalog, but it might become a burden if a particular library were to be included in more than one."[139] In short, this is a time in history when the planning for any particular automated library system or function must take into special account the larger relationships of that system or function. This may, in fact, have been done in Connecticut in planning for the state's union catalog system, but no indication of such planning has come to the attention of the present investigator.

Unlike the UACSC report for Connecticut, Arthur D. Little, Inc. (ADL) stresses New England-wide 'cooperation' in a chapter common to each of its reports for Massachusetts, New Hampshire, and Vermont:[140]

> "Although our work was concerned directly with library service within the Commonwealth of Massachusetts [sic: or New Hampshire or Vermont], it has become increasingly apparent to us that the possibilities of a more far-reaching network of libraries should be considered. The logical extension, in terms of geography and patterns of service, would be a library network encompassing all of New England. While the crossing of state boundaries will undoubtedly raise some problems, the advantages are too great to be ignored ... The establishment of a New England Regional Library Center will be a substantial project and will require considerable planning. The most immediate need is to develop strong library networks within each state. A strong Massachusetts [or New Hampshire or Vermont] network is, of course, the major concern of this report. Improvement in state-wide library service will be the continuing goal of those concerned with library administration in Massachusetts [or New Hampshire or Vermont]. While these improvements are being made, however, there should be a concomitant effort to improve cooperation among the New England states. This cooperation should be deferred until all aspects of a sophisticated system can be worked out." [N.B. Underlining the author's]

One may reasonably wonder how cooperation can be concomitantly improved while it simultaneously is being deferred! The only positive inference about cooperation that can be drawn from the ADL recommendations is the existence of a belief that regional need will be automatically served subsequent to the resolution of state needs within six separately specified library environments by six separately planned 'sophisticated' systems.

The validity of this belief may be vindicated with the passage of time, but Purdy has perhaps gotten to the core of the problem associated with state-based and regionally uncoordinated 'regional planning' with his observation that:

> "The creators of the state plans have (inescapably) thought largely in terms of intrastate library net-

> works, but the geographic area encompassed within state boundaries is certainly not always the optimum area for a library network. The state makes sense as a source of support, legal authorization, stimulation, organization, and administration, but not equally as a unit for resources development or optimum access. Many of the state plans recognize these facts by authorizing network agreements beyond state boundaries, but I think that the basic point has received less attention than it must be given."[141]

Nonetheless, wherever it is possible to create a state union catalog, if only because that configuration may be easier to achieve than the single regional union catalog,

> "There is no reason to discourage such efforts just because the area is too small, but it should be recognized that in the event of the creation of a union catalog for a larger region, the prior and smaller catalog would necessarily become a subregional catalog whose responsibility would be to contribute ... to the new regional union catalog. This conception looks to the growth of union catalogs through a series of purely local efforts, one catalog after another falling into a regional pattern, and each including a number of subregions that contribute ... to their respective regional union catalog. If a national union catalog were then organized to include all of the regional union catalogs, these catalogs would be responsible for sending the accessions of all their participating libraries and subregional union catalogs to the national union catalog."[142]

Even this conception, however, requires not 'deferred' but immediate cooperation, if only in the area of attempting to establish regional (and national) guidelines that will make present automated union cataloging (and other) activities viable and efficient, at least in terms of probabilities, for the future. Mrs. H. D. Avram, who is always cognizant 'of the larger picture', has aptly expressed the Library of Congress' awareness of this need:

> "Any consideration of a national bibliographic data store in machine readable form should include the possibility of recording titles and holdings from other libraries. Although the resolution of the problems associated with a machine readable national union catalog are enormous, it is time to begin an exploration of the problems to provide guidance for future design efforts."[143]

The RECON Working Task Force, of which Mrs. Avram is Chairman, has already taken steps to provide some of this guidance:

> "On the basis of present knowledge, it seems that machine readable records will serve two primary functions for national use. The first involves the distribution of cataloging information in machine readable form for use by library networks, library systems, and individual libraries; the second involves the recording of bibliographic data in a national union catalog to reflect the holdings of libraries in the United States and Canada ... called the national union catalog (NUC) function ... It is possible ... to define a subset of content designators to cover the eventuality that outside libraries may be able to report their holdings to NUC in machine readable form. A MARC subset can be determined for the NUC function because this function involves processing records in a multiplicity of places to be used centrally for specifically definable purposes ... The specifications of a machine readable record to fulfill the NUC function depend on the nature and functions of the national union catalog itself. The content designators for such a record will be defined in a separate investigation now being conducted by the Working Task Force."[144]

Kuncaitis notes that a number of authors have stressed "The importance of establishing standards of cataloging and of codes for contributing libraries ... this being a prerequisite for the uniformity of a union catalog."[145] Insofar as the code for contributing libraries is concerned, New England is a good example of the complexities that arise when state union catalogs are separately established without coordination and adherence to standards. The New Hampshire union catalog uses NUC symbols, but local sets of symbols are used in Connecticut[146] and Vermont.[147] The whole question of library identification systems will shortly be under review by a subcommittee of American National Standards Institute's Standards Committee Z39,[148] and it is important for New England's union catalog 'planners' to relate to the work performed by such standards setting activities, and to explore the consequences of the already existing proliferation of identification codes in New England on projected automated systems designs.

Such examples only reaffirm the need to undertake regional planning, coordination, and cooperation for union catalog implementation, whatever the configuration decided upon, now.

SECTION 3: THE INTERINSTITUTIONAL UNION CATALOG

An unequivocal example of a major interinstitutional union catalog which was established solely for union catalog purposes is difficult to come by, unless one includes the subject-oriented union catalogs that came into being after 1920, and whose development roughly paralleled that of the general union catalogs.[149] By and large, the former "are not subject catalogs in the ordinary sense ... but are, rather, author catalogs whose entries are restricted to works on a particular subject."[150] Although the libraries inventoried in such subject union catalogs are often contained within a definable geographic area, the primary reason for their contribution to the union catalog is their common concern for the given subject of the union catalog rather than their common geographic location. (The wide range of special subjects for which union catalogs have been compiled is apparent from Berthold's Directory,[151] which includes those that had been compiled to that time in New England.)

Of more contemporary relevance is the Union Catalog of the Oregon State System of Higher Education;[152] a general rather than a subject union catalog. Merritt, who in any event should have considered any interinstitutional union catalog to have been just another kind of regional union catalog, points out that "In Oregon, for example, the union catalog is limited to those institutions of higher education that are members of the Oregon State System. Since the union catalog was planned at least in part as a tool to facilitate central ordering, there was no necessity for including other than the six libraries in the state system."[153]

This pattern, involving not so much a special purpose union catalog as a general or multiple purpose catalog having union catalog capabilities, will undoubtedly assume increasing importance in New England and elsewhere over the next few years, as more and more library consortia turn toward the cooperative utilization of automated techniques. The general purpose catalog already under development for NELINET is a prototype of the pattern in New England.[154] The so-called 'Books for College Libraries Project'[155] initiated by the Massachusetts Board of Higher Education to strengthen the deficit collections of the state's public institutions of higher education involves automated book ordering, selection, and processing activities at the University of Massachusetts at Amherst that could lead ultimately to a union catalog situation somewhat comparable to that described for Oregon, above. The inchoate plans of the Worcester Area Cooperating Librarians (WACL) and the Boston Theological Institute (BTI) for automation projects also may culminate eventually in such union catalog capability, and it is to be expected that there will be a proliferation of such interinstitutional 'union catalogs' in

Obviously, and even more so than is the case with an array of state union catalogs, the extent to which a large number of such interinstitutional union catalogs, perhaps in conjunction with two or more state union catalogs, can collectively meet the collective regional union catalog need undoubtedly will be most adventitious. The logic that motivates a particular group of libraries to come together for a variety of cooperative automated purposes may not be based at all on those elements of collection size and uniqueness that make for strong union catalog capabilities. The best that can be hoped for is that the guidelines that might be established for regional and state union catalog development would be adhered to by the developers of interinstitutional union catalogs.

CHAPTER III: THE RELEVANCE OF NELINET'S UNION CATALOG CAPABILITIES TO NEW ENGLAND'S UNION CATALOG NEEDS

Unlike the union catalogs, actual or proposed that have been discussed in the preceding chapter, the NELINET catalog is not a special purpose catalog devised for union cataloging purposes, but is instead a general-purpose catalog possessed inherently of union catalog capabilities. As previously noted (page 2, above), this general purpose catalog will essentially take the form of a central file of machine readable bibliographic and local library data bases. The contents of these data bases will be capable of being accessed either directly in the form of on-line man-machine interactive modes, or indirectly in the form of catalog cards or book form catalogs and other listings produced from these data bases. The different data bases will be created in different ways, at different times, for different purposes. However, wherever possible, data file creation will be multi-purpose in character. Thus, the first data base created for NELIENT consists of a constantly cumulated file of the bibliographic records created by the Library of Congress for its current imprint English language cataloging output, the so-called LC MARC II records. Simultaneous with the creation of this NELINET-LC MARC II data base, however, is the production of cards and labels previously described (pages 2-3, above).

The completion of the work done pursuant to the present grant will create a second data base, i.e., the local library holdings file. This file is conceived of presently as containing *all* of the information that a library *must submit* if it wishes to receive catalog cards and labels for a specific bibliographic item. One of these items of information is the library's identification symbol, and the retention of that data element represents an automatic infusion into the NELINET system of union catalog capability, since the NELINET holdings file contains this kind of input for several libraries. Looked at another way, it may be said that the NELINET libraries, as a *by-product* of data file creation and catalog card production are creating a union catalog of their holdings.[156]

The Library of Congress MARC program will hopefully expand in future to cover all Roman alphabet current cataloging output (for current imprint monographic materials, at least). For current acquisitions not covered by the Library of Congress MARC program, the NELINET libraries propose to share the original cataloging load, creating machine readable records for these items which will be used in much the same manner as the present LC MARC II records to simultaneously produce catalog cards and holdings file, including union catalog, capability.

Thus, at the point in time when the NELINET libraries are capable of data file creation for their entire current acquisitions load, union catalog creation and maintenance will be an on-going operation taking place as a by-product of normal library activity, rather than, as is the case for all extant union catalogs, being a discrete additional library activity. In this respect, there would seem to be subtle, if not invariably clear, differences between the catalog projected for the NELINET libraries and the catalog proposed by UACSC for Connecticut's libraries; the latter is still primarily a special purpose catalog created for union cataloging purposes, and although it may be used for multiple purposes, partly because it has the inherent flexibilities of the machine form catalog, partly because other special purpose equipment can be used in conjunction with it, the insertion of holdings data into it is still essentially an additional activity: "It is recognized that considerable effort will be required of each library if the holdings file is to be kept current and accurate."[157]

Older materials represent a somewhat different problem with respect to union catalog creation, however. At its worst, the problem is no different from that confronting anyone desirous of creating a union catalog (in card or machine form) covering materials already in the possession of the participating libraries, or of converting existing card form union catalogs to machine form, that is, it involves a complicated and costly additional library activity. A number of developments under way at this time, such as the Library of Congress RECON (retrospective conversion) Project,[124] or the perfection of automated format recognition techniques, may ease the problems associated with this additional conversion requirement, but the actuality and extent of that amelioration can only be speculated upon at this point.

There are some possibilities for NELINET's retrospective conversion approach, however, that are not open to special purpose union catalog projects. The most significant of these involves the sharing of the load among the participating libraries; this could be coupled with reclassification and book catalog input needs to introduce once again the concept of multiple purpose file creation. However, a number of operational and bibliographic considerations, including the impact, in time and scale, of LC's RECON Project, must be more precisely elaborated before such 'distributed' cataloging loads can (or should) be undertaken.

Given the existence of a NELINET machine form union catalog capability, it is appropriate to examine briefly the ways in which that capability might be utilized. In the first place, like any other machine form union catalog, except the kind that was proposed by Schreiber, it will have all of the flexibility associated with that catalog medium. Thus, although most card form union catalogs are, of practical rather than theoretical necessity, main entry catalogs only, the machine form union catalog will be inherently accessible through all of the normal entry points--author, subject, title--as well as through numerous other content designators, such as year of publication, LC card number, publishers, etc.

Secondly, the contents of the machine form union catalog can be printed out to produce book form union catalogs that can be used at locations remote from the catalog itself, and that can be periodically updated. Despite the fact that it can be done, even for enormous-sized catalogs, as evidenced by the Library of Congress printed catalogs, it may be said generally that card form union catalogs do not have this flexibility; the suggested use of a microfilmed copy of a card form union catalog in lieu of a book form one does not really alter this condition, since the updating of this microfilmed version would be a difficult proposition at best.

However, it is in the realm of on-line access and general purpose utilization, that the NELINET catalog may be distinguished most significantly from the special purpose union catalog in machine form, such as that proposed for Connecticut by UACSC. One conjectured use of the NELINET system is for on-line regional circulation control. In an environment of that type, the NELINET union catalog capability would be expanded beyond the usual realm of locating libraries to facilitate interlibrary loan by determining whether the bibliographic item sought was actually available (i.e., assumed to be on shelf) or out in circulation at the time of the request.

Thus, the theoretical union catalog capabilities of the NELINET general purpose catalog may be seen to have numerous possible ramifications for the participating libraries, some of them quite spectacular in terms of removing certain traditional constraints upon certain library activities and services. How relevant, then, in fact, is this NELINET catalog to New England's union catalog needs?

Although it has already been indicated that the union catalog needs of the six state New England region have not been specified in any meaningful terms, for purposes of the examination required to answer the above question it will be assumed first that New England needs a single union catalog to serve the region, as Merritt suggested. How relevant to that assumed need is NELINET?

The answer to this question may be sought from several points of view. The most significant of these from a technical standpoint involves the system's capacity in terms of the number of libraries that it can handle. The computer used in the NELINET system, the Digital Equipment Corporation PDP-10/50, can be linked to up to 128 terminals for on-line operation. Since there are 234 academic institutions alone in New England,[158] all of which have at least one library and some of which have a large number (Harvard, for example, has nearly 100), it would appear, on the face of it and without reference to the numerous operational and optimizational variables involved, that the NELINET system is incapable technically of handling the New England academic library community, let alone the several hundred public and special libraries in the area. However, it may be observed that the essential issue is not the absolute number of terminals, i.e., libraries, that can interface the computer, but the quantity and quality of the demands made from those terminals upon the computer. The service capacity of the NELINET system has been described in the following way:

> "The time shared system will make possible full technical processing services including acquisitions control; and more importantly, will permit on-line interrogation of the file in support of acquisitions, cataloging, and reference ... It is estimated that up to 64 large libraries can readily be served. This is based on a dual-access moving-arm disc system, where service is assumed to be access-limited. A typical multiple access retrieval request is estimated to take 600 milliseconds to effect. We estimate that it will be possible to achieve about 75% efficiency in simultaneous access, (i.e., 2/3 of the service time overlapped) so that two requests could be served in 800 milliseconds. This assumes directory access to items, and is equivalent to one request per 25.6 seconds per library; or about 1125 requests per day per library. Search access (where directory access is not possible) will be allotted in time slices sufficient to read out 24 tracks of data in one head position (about 340 catalog records, average). This takes about 1350 milliseconds. Dual objectives are to eliminate return to a prior head position to minimize service time, and to reduce the variance of service times allotted to reduce queue length. Optimization studies are in process."[159]

The delineation of technical parameters for an automated library system, however, is only part of the story, and it would appear to the present investigator that the estimate that "up to 64 large libraries can readily be served" is just that, an estimate, about which several 'facts' may be noted:

1. No library data is available to indicate what in fact are the average daily access requirements of

the participating libraries; thus, it is not known whether a 'large' library could be expected to make 112.5, 1125, or 11,250 directory access queries per day;

2. While it is perfectly valid to postulate technical access at one request per 25.6 seconds, it is quite another thing for human performance to approximate technical fecundity. Not until the project is able to acquire some experience with man-machine interactive rates in a real library environment, even solely in terms of directory access queries, can effective traffic rates be determined;

3. Data is similarly unavailable with respect to the 'mix of directory and search access queries. Nonetheless, it is clear that a system that permits on-line interrogation in support of acquisitions, cataloging, and reference is one which will entail a substantial number of search queries.

In the absence of such data, this investigator does not believe that it is possible to determine, in any practicable way, the number of libraries that can participate on-line in the NELINET automation project. As a corollary, it is not possible to determine, in any meaningful quantitative sense, the relevance of NELINET's union catalog capabilities to any assumed requirement for a single regional union catalog for New England. This is not to say that the NELINET union catalog capability may not be technically adequate for this purpose, but only that there is no way of ascertaining this at present. One may reasonably suspect, however, that it would require extraordinarily complex, sophisticated, and expensive optimization of terminal and communications access modes, as well as interlibrary relationships for various library purposes, for the NELINET catalog to function as a regional union catalog in Merritt's all-inclusive sense.

The absence of meaningful data about library access patterns and their concomitant demand upon any projected system also precludes *a priori* any unequivocal determination of the relevance of the NELINET central file to alternative single regional union catalog configurations, viz.:

1. A hybrid system in which some libraries can function on-line in the envisaged way, while the others can contribute input to the union catalog, but must rely on a book form or other printed version of the union catalog for access. Apart from the unspecified mechanical and cost factors inherent in this approach, it has certain theoretical drawbacks:

   a. The on-line libraries would lose the real-time advantages of a combined interlibrary loan-circulation control system whenever the library with the desired bibliographic item is itself off-line. (Again, it must be stressed that the present discussion concerns purely theoretical conditions: it may well be that it is simply too expensive to support a regional circulation control system, or that in a properly constructed network of this type, the off-line libraries would almost never be 'resource' libraries anyway.) Conversely, none of the off-line libraries could enjoy any of the on-line benefits, whatever the library function involved; this would be a far more serious defect for a general purpose machine form catalog.

b. The book form union catalog can never be a full or 'real time' union catalog, and to some authors it is therefore inherently inconsistent with good union catalog practice. Thus, Nakamura, clearly under the influence of Brummel, Willemin, and others, distinguishes between 'a' union catalog (in card form, although he would assuredly have accepted the machine form analog) and the printed union catalog in book form: "The latter is merely a fragment of the former and can cover only a limited period."[160]

2. A single regional union catalog, not of all of the volumes in all of the libraries of New England, but of all of the volumes in all of the research libraries in New England. The establishment of this kind of union catalog, however, immediately weakens the extent to which the catalog can be used as a tool for the study of the distribution of all of the library resources in the region, with its ancillary uses, e.g., coordinated acquisitions, centralized purchasing, etc. Furthermore, an immediate and less theoretical objection to this approach is that it flies in the face of New England library 'political realism', since the two extant state union catalogs already include non-research libraries, and almost any future plans that are geared to meet state as well as regional needs will doubtless require the inclusion of non-research libraries if they are to have functional viability.

In this connection, another way in which NELINET's union catalog relevance for the New England region may be conditioned as much by 'library political realism' as by union catalog theory or limitations on technical service capacity lies in the very nature of the NELINET constituency. It has been noted that the charter members of NELINET are the main campus libraries of the six New England state universities; it has always been assumed, however, that the membership of NELINET would be enlarged, and efforts are now (July 1970) under way to make that assumption fact. The criteria for NELINET membership, and for participation in its automation project are not yet firm, but it would seem reasonable to assume that the initial thrust at least will be for and from the academic and research library community (the sponsoring body, NEBHE, is itself limited by charter to an academic constituency). Since not all academic libraries are research libraries, and not all research libraries are academic libraries, and since most New England libraries are neither academic nor research libraries, the actual NELINET constitutency that is sought, or that evolves, de jure or de facto, will have significant implications for the relevance of the automation project's union catalog capabilities to New England's needs.

Insofar as the relevance of the NELINET catalog to the Schreiber kind of union catalog is concerned, it must be remembered, in the first instance, that the utility of the Schreiber catalog, regardless of the kind of machine form catalog by which it may be implemented, depends upon the utility of the LC card number (or, alternatively, the Standard Book Number, or any other kind of 'universal call number') for facilitating physical access to books. The data available on this point, i.e., the actual utility of the LC card number for this purpose, is still inconclusive.

The Schreiber catalog, as Schreiber conceived it, is always limited, at least in any practical sense, to item location for facilitating physical access, and always requires the insertion of holdings information to be a separate and additional library activity. The NELINET catalog contains all of the holdings information necessary for functioning as a 'Schreiber catalog', viz., the LC card number, the library identification symbol, and the local call number (the latter having been considered by Schreiber to be a possible, but not necessary, additional holdings element), and all of this holdings information may be considered, to all intents and purposes, to have been inserted as a by-product of other NELINET library activities (although it is also possible to insert holdings information for union cataloging purposes only directly into the NELINET central file). However, since the NELINET holdings file corresponds to complete bibliographic records that are also available in its central file, the NELINET catalog is functionally far more flexible than the 'straight' Schreiber catalog, being readily usable for bibliographical searching and for access to information about the distribution of books.

Nonetheless, although the NELINET catalog can function like a Schreiber catalog, and can even perform union catalog

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functions that the latter can not, it is by no means conclusive that the NELINET catalog is the more desirable of the two with respect to ultimately meeting the regional union catalog need by means of the LC card number. The only data elements that Schreiber thought it was essential to store were the LC card number and the library identification symbol; these two elements comprised both his 'holdings' and 'bibliographic records' files. In the NELINET catalog, the data elements stored in the holdings file, each with an appropriate 'tag', include the LC card number, the library identification symbol, and branch or special location designation, a system or transaction number, any relevant copy or volume number, and the local call number. An average NELINET holdings statement is 90 characters; in addition, the corresponding bibliographic record in the NELINET file is an average 584 characters in length.[161] The storage requirements of the Schreiber catalog, and the corresponding supportive cost structure, are unquestionably miniscule in comparison with the costs involved in the NELINET file structure.

The immediate relevance of the NELINET catalog for the Schreiber catalog is that the former exists and the latter does not. To that extent, NELINET may be usable for testing some aspects of the Schreiber catalog that have hitherto been susceptible solely to theoretical discussion. It would still seem, however, that the use of the LC card number (or some alternative 'uniquely' identifying number) for union catalog purposes, and the appropriate means of implementing this in machine form, deserves continued and separate attention.

In order to assess rationally the relevance of NELINET's union catalog capabilities to a multiple union catalog configuration in New England, that is, an array of six state union catalogs, it is probably necessary to divorce the technical component, i.e., the automated activity, from the present constituency, i.e., the six state university libraries, and talk instead about a NELINET-type general purpose machine form catalog of the kind already described.

For this case, the same problem still exists with respect to the lack of data about library access and use patterns. However, for at least some of the New England states, one can intuitively assume a higher probability that the technical capacities indicated for NELINET might encompass the total relevant library constituency.

Marcy, for example, shows the number and types of libraries that have been assigned uniquely identifying union catalog symbols, and that are thus considered to be potential contributers to the Vermont Union Catalog:[162]

	16	academic libraries
	203	public libraries
	1	school library
	6	special libraries
TOTAL:	226	libraries of all types

Although Marcy points out that "the number, 226, is only somewhat indicative of the potential number of contributors rather than reflective of the full potential ... There are school and special libraries, in particular, that are not now contributors,"[163] it might well be assumed that the number, 226, reflects a sufficiently valid functional constituency for purposes of discussing the relevance of a NELINET-type catalog.

Again, although 226 is only 8 less than the 234 academic institutions previously noted as existing in New England, and still lies beyond the absolute limit of terminals, 128, that can interface the NELINET system's computer, the size and character of Vermont's libraries suggest that their access patterns and optimization requirements may more reasonably lie within NELINET-type capacities. One need only contrast the number of volumes held by 299 Vermont libraries in 1965, as reported by Arthur D. Little, Inc.,[164] viz., 2,956,000 volumes, with the holdings of the 152 New England academic institutions for which the United States Office of Education reported statistics as of June 30, 1964,[165] viz., 26,936,597 volumes,[166] to get some idea of the differences of scale involved. (While number of volumes held is only one of the variables that define the scale of library operations, it may be assumed that significant differences within that variable reflect significant differences in operational scale.)

However, although a single state-wide NELINET-type of catalog might have comparable 'intuitive' possible relevance for each of the states of Maine, New Hampshire, and Rhode Island, assessments of its relevance for Connecticut and Massachusetts are best held in abeyance, and especially in the latter, where the number, size, and character of the libraries make the problems of creating a state union catalog almost a microcosm of those encountered in establishing a six-state regional union catalog.

There are some points about the Connecticut situation that can be explored here, however. Because union cataloging has not been a primary functional concern of NELINET's to this point, the project's planners have never really examined the New England library environment from a union cataloging point of view. In Connecticut, however, where the establishment of a machine form union catalog was a primary concern of the investigating United Aircraft Corporate Systems Center, much closer attention was paid to the local, i.e., Connecticut, library environment, and to the interrelationships between it and the projected automated system. Some of UACSC's data is suggestive for possible NELINET-type catalog application to the Connecticut scene. For example,

> "In order to estimate the cost of communications for the Phase II period, and also to give an indication of likely remote console distribution on the State at that time, a brief study of the larger libraries in the State was performed. Included were the industrial libraries listed in the 24th edition of the American Library Directory, academic libraries serving institutions with graduate programs, public libraries serving populations over 30,000, and the State Library. More than one console was allocated to the largest libraries, and one voice-grade circuit was provided for each library, with a maximum of three consoles per circuit. The results are summarized in the following tabulation."[167]

TYPE OF LIBRARY	NUMBER OF LIBRARIES	NUMBER OF CONSOLES	NUMBER OF CIRCUITS
Industrial	40	40	40
Academic	13	21	14
Public	20	29	20
State	1	2	1
TOTALS	74	92	75

Since the Connecticut State Library supported the UACSC proposal before the Connecticut General Assembly,[168] it may be assumed that the State Library was satisfied that the UACSC proposal met Connecticut's union catalog needs. One can therefore accept the above figures on practical, if not theoretical, union catalog grounds, and those figures lie well within NELINET capabilities. However, once again the critical factor in determining the validity of even these figures, the level of usage that will be made of the system, is unknown. UACSC observed that, "In view of the difficulty of arriving at reliable usage statistics, it is possible that modifications in the communications design will be necessary as operating experience is gained."[169]

The essential issue for a NELINET-type catalog in Connecticut remains, then, a matter of the level of demand that will be made upon the system, and such levels of demand are unknown. If the levels of demand lie within NELINET technical capacities, it may well be that there is no justification (in functional or cost terms, at least) for establishing a UACSC type of union catalog in Connecticut, when the state may also have to develop a machine form catalog to handle its centralized technical processing or centralized cataloging requirements. Conversely, if Connecticut's level of demand exceeds NELINET catalog capacities, it will sooner or later be necessary for the state to address itself to the adequate resolution of its union catalog needs.

As has already been pointed out, there is no reason to assume that New England's union catalog needs must or should be met either by a single regional union catalog or by an array of state union catalogs. As Merritt observed:

> "The elements of a pattern for regional union catalogs are present in the United States; we need only examine them with sufficient care to arrive at the formulation of a national pattern for the whole country. Such a pattern will involve no categorical imperative; there will be no indication that it should be thus and not so; it will merely show how a pattern of regional union catalogs for the United States might be worked out. Some other, or indeed any other combination of units might work out as well or better, for the realm of possibility is infinite."[170]

In like fashion, there are no categorical imperatives for the pattern of union catalog development in New England. A number of NELINET-type or other kinds of machine form catalogs within New England, some state-wide, some perhaps interstate, some by type of library within a state or among the states, i.e., interinstitutional, may turn out to be the pattern that evolves within the region. If so, it remains finally appropriate for the present study to examine the relevance of the NELINET-type catalog per se to union catalog application.

That a NELINET-type catalog has an inherent union catalog capability has already been asserted. That capability can be measured in terms of access times or storage capacities, but such technical parameters and capacities are in themselves meaningless unless they are applied within the context of a 'real world' library constituency.[171]

If the pattern of union catalog development that may take place in New England--and probably will--is one that will include a number of NELINET-type catalogs, the pivotal factors that will determine the utility of each of these NELINET-type catalogs for union catalog purposes are not the system's access times and storage capacities, but the geographical and collection characteristics of the constituent libraries. An examination of the present NELINET constituency, and its implications for its own automation project, will serve to focus on some of the elements involved.

Nugent has observed that the six NELINET libraries "have common goals, and as it was discovered, highly similar collections. A statistical study [[172]] of collection duplication with respect to the 30 ordered pairs of the six libraries, revealed that a title from one randomly selected library has a 40% chance of being in any other library. If the choice is restricted to current imprints, the figure rises to 46%."[173]

Obviously, the greater the homogeneity of the constituent collections, the less the utility of those collections for the specific union catalog function of locating bibliographic items not in the possession of any given library in the group. This condition is further aggravated when the size of the constituent collections is comparatively small. As may be seen from Table 3, only two of the NELINET libraries had, as of June 30, 1969, collections exceeding half a million volumes.

TABLE 3: VOLUMES IN NELINET LIBRARIES AS OF JUNE 30, 1969[174]

Institution	Volumes
University of Massachusetts	796,295
University of Connecticut	668,847
University of New Hampshire	483,895
University of Maine	402,249
University of Rhode Island	347,128
University of Vermont	332,378

The union catalog utility for the larger NELINET libraries is still worse. Again, "it is possible to say that the larger a library is in terms of the volumes it holds, the more apt it is to own works that other libraries have not acquired."[117] That Merritt's observation applies to the NELINET situation is confirmed by the Associate University Librarian of the University of Connecticut:

> "In our current situation, certainly, [with respect to] the kinds of material that we are looking for, if we do not have it, the probability of one of the other [NELINET libraries] having it is probably not so great, and so what we depend on is the NUC as a location device."[175]

Nugent further states that "the libraries' geographic proximity is similarly important, since ... The closeness also facilitates other forms of resource sharing such as interlibrary loan."[176] In this connection, two additional constraints must be considered which arise from the assumption that the fundamental reason for seeking bibliographic access in a union catalog is to secure physical access to the requested item.

In the first place, in terms of physical access, 'closeness' is a relative term. The University of Massachusetts is geographically closer to the Hampshire Valley libraries--Amherst College, Mount Holyoke College, Smith College, the Hampshire Inter Library Center (HILC), and the Forbes Public Library in Northampton--than it is to the other state university libraries. As a result of this geographical proximity, a liberal interlibrary loan 'code' within the Valley, and the different collection characteristics of the Valley libraries, the bulk of the University of Massachusetts' interlibrary loan traffic has historically been within this geographic 'sub-region', as is partially evidenced from the data adduced in Table 4, page 56. Similarly, all of the other NELINET libraries have geographically closer intrastate interlibrary loan relationships than they do with each other.

Secondly, 'physical access' must be measured not solely in terms of interlibrary loan, but also in terms of _in situ_ reference to materials that do _not_ circulate in interlibrary loan, or for which the library user desires _in situ_ reference, whatever the circulation status of the item requested may be. Here, too, the distance between any pair of NELINET libraries may be less 'close' than the distance to some local library that also holds the required item.

Thus, homogeneity of collection and relative proximity, while they may be of positive significance with respect to other NELINET objectives, e.g., the sharing of cataloging, reduced machine storage requirements, and reduced communications costs, must be viewed as negative factors with respect to the union catalog utility within the present NELINET constituency. That this is so is reflected in the thinking and attitudes of the NELINET librarians, and in their ordering of NELINET priorities.

Mention has been made of a current attempt to expand library membership in NELINET, and of the fact that the character of that expanded constituency with respect to the number and types of library involved is not known at this time. However, _from the union catalog point of view_, the character of that expanded NELINET constituency, and the characteristics of the constituent collections, will continue to be pivotal to the _internal union catalog relevance_ of the NELINET-type catalog.

On paper, the potentials of the general purpose machine form catalog are enormous; the realization of those potentials is a trickier matter. A. T. Curran has stated the

TABLE 4: UNIVERSITY OF MASSACHUSETTS AT AMHERST: ITEMS BORROWED ON INTERLIBRARY LOAN (BY INSTITUTION) FROM JULY 1966 TO JUNE 1967, INCLUSIVE[177]

3109 items were borrowed from 134 institutions; 1877 of these, or 60.37%, were borrowed from the Valley, 1232, or 39.63%, from outside. The following table shows the institutions from which 10 or more items were borrowed, and, when 1% or more, the percentage of total items borrowed.

INSTITUTION	ITEMS BORROWED	PERCENTAGE
AMHERST COLLEGE[178]	754	24.25
SMITH COLLEGE[178]	615	19.78
MOUNT HOLYOKE COLLEGE[178]	448	14.40
HARVARD UNIVERSITY	172	5.53
YALE UNIVERSITY	123	3.95
DUKE UNIVERSITY	64	2.05
LIBRARY OF CONGRESS	62	1.99
BROWN UNIVERSITY	56	1.80
PRINCETON UNIVERSITY	54	1.73
DARTMOUTH COLLEGE	51	1.64
CORNELL UNIVERSITY	45	1.44
BOSTON PUBLIC LIBRARY	38	1.22
FORBES PUBLIC LIBRARY[178]	33	1.06
COLUMBIA UNIVERSITY	28	
PENNSYLVANIA, UNIVERSITY OF	28	
HILC[179]	27	
UNION THEOLOGICAL SEMINARY	26	
CONNECTICUT, UNIVERSITY OF	20	
CLARK UNIVERSITY	19	
ILLINOIS, UNIVERSITY OF	17	
NORTH CAROLINA, UNIVERSITY OF	17	
VIRGINIA, UNIVERSITY OF	17	
COUNTWAY LIBRARY OF MEDICINE	16	
CALIFORNIA, UNIVERSITY OF	15	
WELLESLEY COLLEGE	14	
CHICAGO, UNIVERSITY OF	11	
HEBREW UNION COLLEGE	11	
MICHIGAN, UNIVERSITY OF	11	
BOSTON UNIVERSITY	10	
FLORIDA, UNIVERSITY OF	10	
MASSACHUSETTS STATE LIBRARY	10	
NEW YORK STATE LIBRARY	10	

case quite aptly:

> "Whether libraries should unite because of location of members, size of collection, type of library (college, public, school), or configurations of subject holdings remains to be seen. NELINET incorporates two of these criteria: the members (at present) are all university libraries (type of library) and are all in the New England area (location of members). But whether this represents the best combination or whether others are better or whether any combination would be equally valid, has yet to be determined. Can the dichotomous needs of shared-resources networks and shared-cataloging networks be reconciled, and, if so, to what extent? On what level? The strength and purpose of shared-resources networks lie in the diversity of the holdings of its members. A major advantage, on the other hand, of a shared-cataloging network lies in the economies attainable through elimination of duplicative efforts and this, in turn, predicates similar rather than disparate collections. Yet, the composite data base, which can be derived from shared cataloging systems, constitutes a powerful finding tool for use in shared-resources networks."[17]

Eventually, the dichotomies of which Miss Curran wrote, will have to be resolved. The union catalog capability of NELINET will have to be assigned some meaningful priority with respect to the other purposes and capabilities of the general purpose NELINET-type catalog. If that priority is high, the satisfaction of basic union catalog requirements will in itself determine the 'functionally relevant' NELINET constituency.

Finally, it should be remembered that, although NELINET may be of dubious potential value for certain configurations that may be preferred from a theoretical union catalog point of view, or for reasons of practical library 'realities', viable alternatives for achieving this preferential condition are not readily apparent at this time. In fact, over the next few years, the NELINET-type catalog may be the only kind of 'union catalog' in machine form that may be supportable by the state-of-the-art, and that is a kind of practical 'reality', too.

CHAPTER IV: CONCLUSIONS AND RECOMMENDATIONS

The present survey indicates the desirability of undertaking an in-depth examination of New England's union catalog needs, and of the means available, if any, for meeting those needs that can be determined. Few studies have addressed themselves to the union catalog requirements of New England as a whole, and to their interactions with any foreseeable national and sub-regional needs. Few studies involving the union catalog requirements within individual New England states have been made in the light of a careful analysis of fundamental union catalog theory and practice, nor have most of them adequately explored the relationship of union cataloging to other library functions, and the interaction of those relationships with contemporary library network and machine form catalog theory and practice. All of these considerations are fundamental to the determination of New England's actual union catalog needs.

Whatever those needs may turn out to be, it is almost a certainty that, if they are to be met at all, it will be through the application of machine form catalog techniques. At the present time, however, those techniques are still highly experimental, especially with respect to the effective utilization of massive files and data bases (such as LC MARC) in actual library environments. Thus, it is difficult to evaluate the applicability of different kinds of machine form catalog, including the general purpose catalog of the NELINET automated project, to a hypothesized range of regional union catalog (and other library) needs.

This difficulty is compounded by the absence of essential information about the characteristics of library environments, and study after study runs up against the problem. A representative expression of the problem may be found in Nelson Associates' study of library service in Connecticut's Capitol Region:

> "Many libraries were unable to answer questions on this study's questionnaire concerning number of reference questions answered, interlibrary loan, numbers of users, size of collections, weeding patterns, and so on, because they did not have the necessary statistics and records to supply the data. The professional librarian knows this is a profession-wide problem and not limited to the Capitol Region, and most librarians are not interested in spending extended periods of time keeping records when they could be serving the library patron."[180]

Many of the statistics now being kept by most libraries are of only partial value for the union catalog planner. For example, the number of volumes held and the number of volumes added are less significant items of information for union catalog purposes than the number of titles held and the number of titles added; yet most libraries keep statistics (often bad) on the former, but not the latter. (In neither case is data on monograph/serials ratios gathered, although this is also significant for union catalog purposes.) Most libraries keep some information on the number of items borrowed and loaned, but few record any information about the time distribution of such items, information which, in conjunction perhaps with comparable circulation data, might dictate the long-range utility of beginning a union catalog from a certain point in time.

More importantly, most libraries keep absolutely no records of the library use patterns of patrons and library workers alike. As a consequence, the level of demand that a library may be expected to make on any projected automated system is seldom known. The proponents of automated library projects, and all too frequently the 'overworked' librarian, tend to view the absence of such relevant data about libraries as an 'immutable' fact of life, at least until the day that an 'operating system' provides the answers. Thus, UACSC, in its *union cataloging study for Connecticut*, advised:

> "The main objectives in studying the requirements of the potential users are to evaluate the need for an automated library center in Connecticut, to determine the specific services that should be offered to enable the librarians to do a more complete job, and to provide direct assistance to the library patrons. It is also desirable to establish a quantitative measure of the use that will be made of the various services offered by the different groups of users. There are obvious difficulties in arriving even at estimates of use statistics. Only experience in operating a system will yield reliable values, and the best approach would appear to be to let the system grow with the actual demand."[181]

But automated library systems, whether of the UACSC or NELINET variety, whether for union catalog or general purpose catalog application, are extremely expensive propositions, and the assumption that the system will 'grow with the actual demand' could turn out to be an extremely costly misassumption if actual demand turned out to be in excess of system capacity, or if an alternative approach more compatible with the actual level of demand could have been employed. With machine form catalogs still in essentially experimental stages, but inevitably on the way, it is time *now* for librarians to begin to pay serious attention to the description of their libraries in statistical terms that facilitate *in advance* the evaluation of mechanized systems, even if that attention requires less investment in other library activities. P. M. Morse, discussing the need for data, states the case well:

> "Data on all of these items [N.B., not necessarily the same as those mentioned by the present author] can be obtained. Most of them are not gathered by most libraries. Expense and lack of librarian's time are the usual excuses given for the neglect. Certainly any of the data mentioned costs time and therefore money to gather; to answer all of the listed questions in detail each year would overburden any library's budget. It is the thesis of this monograph that librarians must learn, just as managers of industrial, mercantile, and military operations are learning, to gather and use data of this kind ... In the near future, the introduction of data-processing equipment in library operations will make it easier to amass the data; librarians should experiment with such data gathering before mechanizing, comparing the various methods of data gathering and the value of the various kinds of data in assisting policy decisions, so the data-processing equipment can be designed to produce the effective data most efficiently. In the end it will be better to buy fewer books, for the time being, in order to collect data."[182]

Since New England's collective union catalog needs and problems have not been specified, particularly with respect to the possibilities of machine application, and since some of the crucial data and analysis required for such specification is not available, unequivocal evaluations of the relative merits of differing union catalog approaches, and of the relevance to such approaches of different kinds of machine form catalog, including the general purpose NELINET type, must be kept in abeyance. However, some tentative assumptions may be made about NELINET's relevance for regional, state, and interinstitutional union catalog application.

It is probably valid to assume that NELINET is not a viable prospect for serving as a single regional union catalog for the New England region. A NELINET-type catalog might function as a state union catalog for the smaller New England states, but some doubts about its applicability in this capacity for Massachusetts and Connecticut exist. NELINET will, of course, imminently become an interinstitutional union catalog in fact, but the union catalog 'power' of an interinstitutional union catalog varies with the collection and use characteristics of the constituent libraries.

In general, the machine form catalog resolution of New England's collective union catalog needs, whatever they may turn out to be, still seems to be several years away. In the interim, the New England library community still has the opportunity to gather the data and make the analyses that will permit it to specify the regional need and best plan for its eventual satisfaction. Therefore, it is recommended that a region-wide survey of all aspects of union cataloging in New England (including the national ramifications), comparable to that which was undertaken for the nation as a whole by the American Library Association in the early 40's, and with particular attention being given to the interrelationships among machine form catalog, union catalog, and library network theories, be undertaken.

Even if that survey fails to culminate in a systematic plan for regional union catalog development at this time, it should be able to establish guidelines and standards for those local union catalog developments, at the state or interinstitutional levels, that may occur over the next few years. The availability of such guidelines and standards hopefully will 'maximize' the prospects for guaranteeing the compatibility of those local developments with any regional union catalog that might ultimately come into being.

It is to be hoped, also, that the proposed survey would involve an analysis of the data gathering requirements necessary to describe library environments for union catalog purposes, either as a direct requirement for the proper conduct of the survey itself, which seems inescapable to the present investigator, or as a by-product of its activities. The availability of such information, and its application at the local level, hopefully will 'maximize' the likelihood that automated systems are designed to meet the actual demand, rather than that they grow to meet such demand.

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   b. "Selected bibliography," pp. 395-402, in *Union catalogs in the United States*, ed. by R. B. Downs.

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2. Final reports:

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   b. Inforonics, Inc., *NELINET - New England library information network: catalog data file creation for the New England regional library technical processing center*. Prepared by J. E. Agenbroad, D. D. Hodgins, R. H. Simmons. Final report, CLR-374, submitted to the New England Board of Higher Education. Maynard, Massachusetts: Inforonics, Inc., June 20, 1968. [ERIC: ED 026 077]

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processing for the libraries of the New England state universities. 2 volumes. Prepared by J. E. Agenbroad, L. F. Buckland, A. T. Curran, D. D. Hodgins, W. R. Nugent, R. H. Simmons. Final report, contract no. CLR-385, submitted to the New England Board of Higher Education, Maynard, Massachusetts: Inforonics, Inc., April 5, 1968. [ERIC: Vol. I, ED 026 078; Vol. II, ED 026 079]

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3. L.C. Merritt, "The administrative, fiscal, and quantitative aspects of the regional union catalog," in Union catalogs in the United States, ed. by R. B. Downs. Chicago: American Library Association, 1942; p. 3.

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5. L. Brummel, Union catalogues; their problems and organization. (Unesco Bibliographical Handbooks, 6.) Paris: Unesco, 1956; pp. 28-34.

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8. Merritt, op. cit., p. 26.

9. Willemin, op. cit., p. 3.

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11. Ibid., p. 19.

12. Ibid., p. 18.

13. Ibid., p. 28.

14. R. B. Downs, ed., Union catalogs in the United States. Chicago: American Library Association, 1942.

15. Merritt, op. cit., pp. 3-125.

16. Downs, op. cit., p. xx.

17. Merritt, op. cit., p. 107.

18. A. B. Berthold, "Directory of union catalogs in the United States," in Union catalogs in the United States, ed. by R. B. Downs. Chicago: American Library Association, 1942; pp. 357-358.

19. Ibid., pp. 365-366.

20. Ibid., pp. 366-367.

21. Merritt, op. cit., pp. 117-118.

22. Ibid., p. 118.

23. The two tables are based upon data presented in Table 45, Merritt, op. cit., p. 111.

24. Merritt's data for research libraries was drawn from Table 39 in L. R. Wilson's The geography of reading (Chicago: American Library Association and the University of Chicago Press, 1938). Research libraries were defined by Wilson to include: (1) all state libraries, (2) public libraries of over 250,000 volumes, (3) general college and university libraries of over 75,000 volumes, (4) technical college libraries of over 25,000 volumes, and (5) all other research collections.

25. Merritt omitted the volumes included in the Providence and New Hampshire union catalogs from his calculations, because in both cases he felt that it would be necessary to copy the entire catalogs of the contributing libraries if a complete union catalog were contemplated. His discussion of this problem occurs on page 118.

26. Merritt's costs based on unit cost of \$0.0252 per volume derived from unit cost of \$0.0584 per location developed in Chapter III and ratio of 2.32 volumes per title shown in Table 36, p. 90 of Merritt's work.

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33. T. J. Galvin, "Through the bibliographical labyrinth: a reference librarian's introduction to the Library of Congress printed catalogs," Bulletin of Bibliography, vol. 24, 1966; pp. 229-232, 240.

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39. Ibid., p. 79.

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42. Kuncaitis, op. cit., pp. 16-17.

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45. Dewey, op. cit.,

46. Ibid., p. 37.

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58. _Ibid_., p. 13.

59. Schreiber III, p. 5.

60. W. R. Nugent, "Statistics of collection overlap at the libraries of the six New England state universities," _Library Resources & Technical Services_, vol. 12, 1968; p. 31.

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    b. H. C. Norton, "The W. P. A. union library catalog," *Bulletin of the Free Public Library Commission and of the State Library*, vol. 37, 1941; pp. 2-3.

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93. *Ibid*., p. 13. A somewhat similar affirmation of the *primary* need to strengthen local holdings, with an

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119. *Ibid*.

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123. Mr. Marcy refers here to the bibliographic item already described in this report in reference no. 87, item d.

124. *Conversion of retrospective catalog records to machine-*

readable form; a study of the feasibility of a national bibliographic service. Prepared by the RECON Working Task Force: H. D. Avrom, Chairman; W. R. Nugent; J. S. Pulsifer; J. C. Rather; J. A. Rosenthal; A. B. Veaner. Washington, D.C.: Library of Congress, 1969.

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128. United Aircraft Corporate Systems Center, *op. cit*.

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130. United Aircraft Corporate Systems Center, *op. cit.*, p. 8.

131. K. Mallison, "A union catalog and centralized processing," *CLA News and Views*, vol. 10, 1969; pp. 17-19.

132. Funk: unstructured interview, June 15, 1970.

133. Specifically, according to Mr. Funk (telephone communication, August 4, 1970), because (1) on many of the older cards, the Library of Congress card number appears in such miniscule type that it is difficult to read, if not totally illegible, on a microfilm reader; (2) about 15% of all books published never receive an LC card number anyway; (3) many of the books [in the Bridgeport Public Library in this case] were prepared with non-LC cards on which no LC card number was supplied.

134. "Connecticut prison inmates producing union catalog," *Library Journal*, vol. 94, 1969; pp. 934, 936. The article is cited in the text in its entirety.

135. $500,000 union catalog planned for Conn.," Library Journal, vol. 93, 1968; p. 1405.

136. Funk: unstructured interview, June 15, 1970.

137. This might be of possible special significance for any Schreiber-type catalog that went far enough back in time, and that relied on a microfilmed shelf list with subsequent keying of input data for retrospective conversion.

138. United Aircraft Corporate Systems Center, op. cit., p. 7.

139. Merritt, op. cit., p. 106.

140. In the Massachusetts report (Library planning study: Massachusetts), the chapter (Chapter V, pp. 72-74) is entitled "New England library cooperation"; in A plan for library cooperation in New Hampshire (Chapter IV, pp. 52-54) and A Plan for library cooperation in Vermont (Chapter III, pp. 45-47) the chapter is entitled "A New England library network". The passage cited is from page 73 of the Massachusetts report.

141. Purdy, op. cit., p. 63.

142. Merritt, op. cit., p. 107.

143. H. D. Avram, "The RECON pilot project: a progress report," Journal of Library Automation, vol. 3, 1970; p. 106.

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145. Kuncaitis, op. cit., p. 12.

146. Funk, op. cit. (reference 109), p. 3.

147. "Vermont's union catalog," Bulletin of the Free Public Library Commission and of the State Library, vol. 48, 1952; pp. 20-23.

148. "SC/30 - identification code for libraries," News about Z39, April 1970; p. 5.

149. For discussion, see Merritt, op. cit., pp. 8-9.

150. Merritt, op. cit., p. 8.

151. Berthold, op. cit., pp. 368-384.

152. Ibid., p. 362.

153. Merritt, op. cit., p. 17.

154. The present author did not feel it was worth worrying about whether this 'honor' might not more appropriately have been conferred upon the earlier Columbia-Harvard-Yale cooperation in the area of medical literature.

155. "The 1969 Legislature appropriated $2M, plus modest processing costs, for all 27 State-supported institutions of higher education to acquire copies of many of the books they lacked from Books for College Libraries, a list of some 57,000 titles considered basic for a college library ... the University Library coordinated the selections of the 27 institutions and was prevailed upon to contract for their acquisition, cataloging, and distribution ... The University Library will also gain a number of books from this project, and hopes to demonstrate that higher education in the state can be served better by cooperation than by division of interest between the colleges and the University. The Governor has recommended $2M for a similar project for Fiscal 1971." Source: "Books for college libraries project," Library Newsletter (University of Massachusetts at Amherst), vol. 1, no. 1, March 1970; p. 6.

156. It should be stressed, however, that when the work done pursuant to the grant is completed, it will be possible for a library to input holdings information directly into the central file for subsequent union catalog purposes, without reference to other library functions, e.g., catalog card production.

157. United Aircraft Corporate Systems Center, op. cit., p. 32.

158. New England Board of Higher Education, Facts! about New England colleges universities and institutes 1969-70. Wellesley, Massachusetts: New England Board of Higher Education, 1969; p. 16.

159. W. R. Nugent, NELINET - the New England library information network. A paper presented at the International Federation for Information Processing IFIP Congress 68, Edinburgh, Scotland, August 6, 1968. Separately issued by: Inforonics, Inc., Maynard, Massachusetts, 1968; p. 3. An extended treatment of NELINET service capacity may be found in:

Inforonics, Inc., NELINET - the New England library information network: development of computer programs and pilot operation of a center to perform technical processing for the New England university libraries. Prepared by W. R. Nugent. Quarterly progress report of CLR-385, submitted to the New England Board of Higher Education. Maynard, Massachusetts: Inforonics, Inc., November 20, 1967; Appendix II: Technical Memorandum No. 249: Estimated NELINET service capacity with the Bryant disc file and preliminary design of queue servicing system.

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161. William R. Nugent, Vice-President, Inforonics, Inc., Maynard, Massachusetts: personal communication, July 20, 1970.

162. Marcy, op. cit., p. 4.

163. Ibid. Subsequent to the preparation of this passage, Mr. Marcy advised (reference 90) that: "Within three months we intend to begin a systematic campaign to encourage full participation by these 275 libraries [listed in the Vermont Library Directory-1970] and any additional library that is not now included in the Vermont Library Directory. This latter category is composed primarily of some 200 school libraries that are not now included in the Vermont Library Directory. The total number of potential contributors to the Vermont Union Catalog that we are aware of at this point is 475." Since the present author had already made the point that he was concerned about the way that a NELINET-type catalog would be able to interface a library community that far exceeded 128 units, he felt it was sufficient to go on with the analysis based upon the 226 libraries whose impact had already been felt in varying degrees upon the VUC.

164. Arthur D. Little, Inc., op. cit. (A plan for library cooperation in Vermont), p. 57.

165. United STates Office of Education, Library statistics of colleges and universities, 1963-64: institutional data. (OE-15023-64) Washington, D.C.: United States Government Printing Office, 1965. Comparable information was not available for 1964-65.

166. A breakdown of this figure, by state, number of libraries, and number of volumes, follows:

State	No. of Libraries	No. of Volumes
Connecticut	26	7,249,323
Maine	16	1,223,139
Massachusetts	78	14,734,967
New Hampshire	11	1,495,293
Rhode Island	10	1,546,604
Vermont	11	687,271
TOTAL:	152	26,936,597

167. United Aircraft Corporate Systems Center, op. cit., p. 55.

168. "To accomplish these goals [viz., those established by the United Aircraft Corporate Systems Center's study], the State Library has included cost estimates in its budget for consideration by the 1967 State Legislature." Source: Planning for a Connecticut library research center (reference 129), inside front cover.

169. United Aircraft Corporate Systems Center, op. cit., p. 40.

170. Merritt, op. cit., p. 100.

171. For this reason, it is pointless to devote much attention in this paper to hypothetical library collection sizes and system storage capacities. Nonetheless, the study of the distribution of library resources in New England, if undertaken and expressed in meaningful statistical terms, would be an extremely valuable future endeavor.

172. W. R. Nugent, "Statistics of collection overlap at the libraries of the six New England state universities," Library Resources & Technical Services, vol. 12, 1968; pp. 31-36. [N.B., actually references as (7) in the cited passage.]

173. Nugent, op. cit. (reference 159), p. 2.

174. Data obtained from the head librarians and/or their representatives at the six institutions.

175. Norman D. Stevens, Associate University Librarian, University of Connecticut, Storrs, Connecticut: transcribed from a tape recording of a meeting of NELINET librarians held in Bedford, New Hampshire, January 5, 1970.

176. Nugent, loc. cit.

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181. United Aircraft Corporate Systems Center, op. cit., p. 12.

182. P. M. Morse, Library effectiveness: a systems approach. Cambridge, Massachusetts: MIT Press, 1968; p. 5.

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A. M. Donley, Marginal libraries and information agencies. A proposal for an integrated study of cooperation and coordination in acquiring, cataloging, storing and disseminating multi media resources. [Boston: Northeastern University, 1959.] A paper presented at the New England Technical Services Librarians Regional Meeting, Northeastern University, Boston, Massachusetts, May 18, 1961.

K. M. Holden, Strengthening and sharing library resources in Connecticut. Hartford: Connecticut State Library, April 1970.

M. Turoff, A computerized regional union catalog for library books. [February 1964?] This mimeographed paper is substantively related to the work described by Louis Schreiber (references 44, 49, 52).

I. A. Verschoor, Library services for Vermont. Albany, New York: July 1966.

FINAL REPORT

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DEVELOPMENT OF A MACHINE FORM UNION CATALOG FOR THE NEW ENGLAND LIBRARY INFORMATION NETWORK (NELINET)

PART II

SYSTEMS DESIGN AND PROGRAMMING

by

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Bureau of Research

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IV. TECHNICAL DESCRIPTION OF PROGRAMS

SUMMARY

The purpose of this project has been to develop the essential capabilities for a machine form union catalog of books and a printed union catalog of books for the New England Library Information Network (NELINET). This has been accomplished by means of:

1. A study of machine form union catalog needs.
2. File design for both present and projected needs.
3. The development of techniques and programs for collecting, storing and updating library holdings data.
4. The development of programs to produce a printed union catalog in which the Library of Congress card number is used as the identifying element.

Access to a printed union catalog will be of immediate aid to students and scholars as well as librarians for inter-library loan and acquisitions. The machine form union list is a major step in NELINET's development and provides a basis for the future design of further capabilities: a Network library management information system, an automated inter-library loan system, a common circulation system, and an on-line retrieval system. The recommendations that conclude this report include the development of the above systems as well as research into the practicality and feasibility of including non-MARC data in the holdings file, intensified study of retrieval techniques by author, title, and subject information, and a study of terminals and query/response languages.

1. INTRODUCTION AND BACKGROUND

1.1 HISTORY AND OBJECTIVES OF THE NEW ENGLAND LIBRARY INFORMATION NETWORK

The New England Library Information Network (NELINET) began as a study project in late 1966 by the New England Board of Higher Education to establish a regional center for providing automated computer-assisted techniques to a network of libraries on a cooperative basis. One of the major concepts on which the network was founded was the use of a central data bank of bibliographic and institutional data for the sharing of resources in the form of technical processing and bibliographic products and services. Some of these are: a union catalog for the network of participating libraries; cataloging support and products; shared control of acquisitions, circulation, and inter-library loan; book catalogs, book lists, and demand bibliography preparation; library management information systems; internetwork communication via on-line terminals.

After a year of system design and planning, a telecommunication network was put into operation in 1967 to implement the projected development. The first participating members were the libraries of the six New England State Universities. The original data base was composed of the experimental MARC I tapes, produced by the Library of Congress to determine a uniform standard for machine readable bibliographic data. The original emphasis of the project was on a phase of the planned network that was considered of most immediate need - the production of cataloging support and products to aid the libraries in overcoming the growing problem of backlog, i.e., books which were in the library, but not processed for use. Two of the major causes of backlog were the absence of cataloging information necessary to process books and the scarcity of trained library personnel.

Two NELINET projects completed prior to this present effort encompassed: 1) a pilot study with experimental MARC I tapes and 2) a research period with MARC II tapes, the standard format determined by the MARC I experiment that gives full coverage of current English language monographs, or around 100,000 titles a year. During these developmental stages emphasis was placed on the creation of an automated system leading to the production of catalog cards, book labels, and book pocket labels tailored to the needs of each participating library, but based essentially upon the MARC II bibliographic format. By late 1969 this system was put into regular operation. The research and design for this cataloging products subsystem was accomplished within the plan of overall system development and centered around a central machine form catalog capable of being queried and used in a variety of ways within a variety of bibliographic contexts.

1.2 CURRENT CONTRACT FOR THE DEVELOPMENT OF A MACHINE-FORM UNION CATALOG FOR NELINET

In the same sense that cataloging products were not produced as an end in themselves, but as part of network design and development, the present project to produce a union catalog containing the holdings data of the member libraries has been developed as a tool for performing certain functions that are a part of future development of the network, e.g., book location, loans assistance, acquisitions coordination, bibliographical information, etc. The technical emphasis in this project has been of two parts: 1) to provide means for the direct storage, addition, and updating of local holdings information, and 2) to develop means for incorporating this data as a part of a basic machine form catalog. This work, therefore, has consisted of two main activities: 1) file design and creation, and 2) the development of means for efficient utilization of the file in the future system. Although the immediate utilization of this file under the present contract is for production ability of a regional union catalog in book form, the design had to encompass future possible needs for sub-regional and institutional book catalogs and direct access to the file for circulation control, acquisitions and interlibrary loan. Thus, the union file of holdings was designed to be responsive in the future to five basic retrieval questions:

a) Does an item exist in the region?

b) What is the distribution of copies?

c) What is the closest source?

d) Does the item circulate on interlibrary loan?

e) Where are subject concentrations heaviest?

The programs and procedures implemented to create the Machine-Form Holdings File are thus of very broad utility whenever local information is to be stored, updated, linked to the NELINET MARC II file, and retrieved for reference or printout.

The project had five broad objectives:

1. Exploration of the means for the storage, addition, and updating of holdings data acquired from:

a. Libraries requesting catalog products as currently available. -- This is the usual case, and here holdings data is captured as the request for processing is made. Two identifiers serve to locate (and protect) the holdings file: the L.C. Card Number and the Systems Number. The L.C. Card Number is necessary to add holdings data, and both numbers are required to update holdings data. The Systems Number is a short code containing library identification and a date and sequence code, and this number appears on all requests, whether for processing or for holdings file modification. In use, it insures that the correct holdings file is addressed for change operations.

b. Libraries not requesting such products. -- In this case, new holdings records are added or modified, without card processing. The holdings file however, is considered as an extension of the LC MARC II file, and requests for establishing or modifying holdings records are keyed to the MARC file. Requests for establishing holdings records for which no MARC record exists, are rejected and an error message is generated.

2. Derivation of absolute and comparative cost data with respect to (a) and (b) in Paragraph 1 above.

   These costs are treated in detail in section 3.3 of this report, and indicate that holdings records can be stored quite economically in the present system, with costs of about $0.001 per holdings record per week.

3. The design of an efficient file organization that can encompass the holdings records of the New England Region.

   An extensive study of file organization was performed during the initial period of this contract. This study concentrated on the disc-oriented system that will soon be required, for reasons of efficiency, to replace the present tape-oriented system that is currently most economic with the present file size. This report is contained as Appendix III of this report.

4. The study of the utilization possibilities of a machine-form union catalog for the production of regional, sub-regional, and institutional book catalogs.

   The Holdings File Processing Program will permit the production of book catalogs from the complete regional holdings file or from the files of a specified institution only, or from any specified collection of institutions. This can further be conditioned by specifying a starting date, so that listings can be produced to represent items acquired for any given time span, from the present back.

5. The writing of a program that will permit the production of a union catalog in book form, based on the L.C. Card Number to identify each book.

   The Holdings File Processing Programs, a collection of routines that comprises the major work under this contract, include routines for the line printer listings of a book form union catalog in L.C. Card Number order.

The Holdings File Processing Programs are described in Section 4, and their technical documentation is included in Appendix IV. They perform the following functions:

a) Sorting and merging MARC II bibliographic data and institutional holdings data into a composite file organization.

b) Extraction and sorting of records from the composite file as required to produce a machine file of membership holdings in L.C. Card Number order.

c) Line printer listings of the machine file to produce a printed union list of regional holdings.

A sample of a line-printer produced book form catalog in L.C. Card Number order is included in Appendix I of this report, and represents one of many possible output formats that can be readily modified.

The Machine-Form Holdings File is the core of the present development, however, from which many forms of information and printed output can be derived.

2. IMPORT OF UNION CATALOG CAPABILITY

2.1 IMMEDIATE USE TO SCHOLARS, STUDENTS, AND LIBRARIANS

A union catalog is a list of bibliographic items held by several libraries and thus is a major means of sharing library resources among academic institutions. The most immediate import of NELINET's union catalog capability is the ability to create, on demand, a printed union list of all of the participating libraries, a limited number of libraries, or of one institution. Such printed catalogs also have immediate usefulness in the areas of individual library management and acquisitions as well as cooperative acquisitions policies and interlibrary loan.

2.2 IMMEDIATE USE TO NELINET

Previously, the only service the Network has offered libraries has been cataloging products. The holdings data on every request for cataloging products (library identification, branch and location data, copy data, and local call number) has been used strictly for the output of catalog cards, book labels, and book pocket labels. Now the ability to save this local data in the master-file for union catalog purposes and to do so without getting cataloging products offers the possibility of becoming a member of the Network to many other libraries in the region who, for economic or practical reasons, have not desired the cataloging services.

Union catalog capability is a very large step in the growth of NELINET as a functioning network because it not only expands the immediate services offered and the use made of MARC data but also is an integral step toward future services and capabilities:

a) User interaction with the masterfile, as opposed to just reading it and using it, is now possible with the new capability to update and correct holdings data.

b) An automated regional circulation system.

c) Aid to regional acquisitions policies.

d) A future automated system for interlibrary loan.

e) A future management information system (MIS) for participating institutions as well as for the Network.

The ability to save local holdings data in an easily retrievable manner is a basis for every future development of NELINET.

2.3 INCREASED FILE CAPABILITY

The major component of NELINET is its data bank, composed presently of MARC II bibliographic records and, soon, of local holdings data; the only functioning criteria of NELINET as an information network are: 1) how well it utilizes this data bank, and 2) how useful the data bank is. Therefore, the major emphasis in all systems design and development has been on means of access to and design of the file. For production of current cataloging products, the Library of Congress card number was determined as the access means because it is common to both the MARC II master file and to the data that the libraries have. Also, it sidestepped the real difficulty inherent in accessing a machine file in the more traditional library methods, i.e., by author, title, and subject. Natural language is very redundant, and the prospect of searching or sorting a large file by natural language is prohibitively expensive in terms of computer time and memory. Although there has been research into the possible use of search codes or word compression codes, there is no definitive, easy means yet determined for searching a file by the traditional author/title/subject data.

Because the Library of Congress card number is used as the access means for cataloging products services, it was decided to continue its use as the access point for holdings data. In this way, the same basic file organization could be utilized, the only change being to add the holdings data after each bibliographic record in the MARC file. Thus, both bibliographic data and holdings information are accessed by the same method, which has already been proven sufficient until such time as the author/title/subject approach has been more fully researched.

The use of the file is efficiently increased by adding the holdings data in such a way that it is locatable by the same means of access used for the cataloging products. Thus, the adding of holdings data is easily made into an automatic part of the cataloging products subsystem, since this will be the case in most instances. However, there are those cases when an institution only wants cataloging data and does not want to create a holdings file until it has in some way altered that data (for example, using a local call number, rather than that provided by the Library of Congress); there will be cases of libraries who wish to record holdings but not receive cataloging products; and there also will be cases of changing previously entered holdings data. By using the same file organization and access point, the holdings data, whether connected with cataloging products or not, can be run on the same subsystem as the cataloging products (see the description of HAMP in Chapter 4, Program Descriptions). One computer

program is used for both the cataloging product subsystem and the holdings file subsystem. Therefore, file use is increased by both increased data in the file and by putting this data in the file at the same time and in the same manner as is used for the cataloging product system already in production use.

2.4 THE PRINTED UNION CATALOG

2.4.1 Schreiber Catalog:

In "A New England regional catalog for books" (Bay State Librarian, v. 55, no. 1, January, 1965, pp. 13-15), Louis Schreiber suggested the creation of a regional union catalog for books in which the Library of Congress card number is used to identify the specific title rather than the author/title information. This concept was appealing because: 1) it eliminated the bottleneck and cost of converting all the bibliographic data in the main entry into machine-readable form (master-file data is stored in an internal machine code and must be converted to ASCII code for printing purposes), and 2) it provided a tool which could "expeditiously" locate a large percentage of a library's inter-library loan transactions with greater accuracy than author/title data, which may easily be erroneous or conflicting in content.

2.4.2 Operational Test Of The Schreiber Catalog:

Because a catalog of this type, completely lacking in printed bibliographic data, which is, instead, represented by a unique identifying number, has not been produced, the NELINET printed union catalog will provide a means of testing, on an operational basis, the utility of this type of catalog for book location and, in particular, for increased efficiency of inter-library loans.

3. METHODS

3.1 HOLDINGS DATA ELEMENT IDENTIFICATION

A study of the data elements required for a union catalog showed that the request data (see sample Request Worksheet on next page) contains all of those elements necessary for a union list by Library of Congress card number except for the Library of Congress call number in the MARC record, which is accepted by four of the five institutions in the Network (only the University of Vermont substitutes a local call number). Therefore, the minimum data elements for the holdings file are:

1. System number (also known as the request number).
2. Library of Congress card number.
3. Location data:
    a. library identification
    b. branch or location data
    c. copy/volume information
4. Call number:
    a. Library of Congress call number, if accepted, or,
    b. local call number

A study of changes made by the NELINET libraries in Library of Congress cataloging copy was conducted for design of the system. Presently, the only change to MARC data is the substitution of a local call number for that provided by the Library of Congress. However, in the future it will be desirable to increase the capability to modify MARC data, and any such modifications of the bibliographic record would have to be included in a union catalog that contained the complete bibliographic record. This study may be found in Appendix II of this report.

3.2 FILE DESIGN AND ORGANIZATION

An extensive literature survey of approaches to file organization was made as a part of this contract to insure that the Holdings File Processing Programs developed would be compatible with the five-year projection of the total system (see Appendix III for the entire report). Although present NELINET operations center around the use of magnetic tapes, all design of files has been done with the intention of converting to random access in future Project development. Such a conversion will be necessitated by the growth rate of the MARC II file. Therefore, the

NELINET MARC II REQUEST WORKSHEET--UNIVERSITY OF NEW HAMPSHIRE

Filled in by Teletype Operator:

req ← nh69- **no mf**

- -

Filled in by Cataloger:

crd ←

	Loc.Symbol(s)	Copy No(s)	Vol.No(s)	No Cd	No S	No Bk	xME
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.
loc ←	1.	2.	3.	4.	5.	6.	7.

call ← ____________________

Valid Location Symbols

Archiv
Biochm
BioSci
Browse
Call
Chem
Eng
German
Hj
j
LS
LSj
LSRef
Math
Mcard
Mfiche
Mfilm
Mprint
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y

report in Appendix III includes proposed design factors for random access as well as for the current use of magnetic tape access. Those design factors that directly influenced the Holdings File Processing Programs as they were developed under the present contract and for the magnetic tape system are:

1) Holdings records are in separate file, and not physically appended or link-addressed to the MARC II file.

2) Primary (one-level) access to both the Holdings file and the MARC II file is by Library of Congress card number.

3) A Library of Congress card number directory, in the on-line (future) system, will contain for each Library of Congress card number in the system, the address of the group of holdings records of that Library of Congress card number, if any.

4) As a consequence of (3), the Holdings file will be in random order, as is the MARC II file, though holdings of the same Library of Congress card number will be adjacent.

Other considerations in the design of the file centered around file size, both immediate and projected. The average length of one holdings record is ninety characters, or fifteen machine words:

Map	3	
Data	6	(library holdings information)
Sort Key	6	
	15	

Description of the map and sort key elements may be found in Appendix IV, Technical Description of Programs. The estimated size of the Holdings file, for 20 institutions, in the Network with an average of 100 requests per institution per week and with 85% found requests is: 85 x 52 = 4420 holdings records per institution per year, or 88,400 records per year for 20 participating institutions.

To assure continuity in projection figures, we assume the same figures as those used in the final report for CLR-443, Computer Programming and Pilot Operations of MARC II Cataloging Support Services. Presently, a weekly MARC tape contains an average of 1500 records, or a total of 78,000 for one year. We use the estimated figures of 100,000 MARC records a year to include current imprint foreign language material and a projection figure of 20 institutional participants in the Network.

With current tape density and the record blocking method implemented with HAMP, an active file of one year's MARC records and one year's holdings file for 20 libraries is easily carried on five magnetic tapes. This does not limit a library to the 100 requests per week average because there is a 2.5 expansion factor in the 5 tape file design. The importance of this fact is that, since both the existing cataloging product subsystem and the holdings file subsystem use the same basic data in the request record, the cataloging products and the holdings records can be created on the same computer run.

Therefore, the file organization is, for the first year, such that the holdings file, although a distinctly separate data base, will be kept on the same magnetic tapes as the MARC II file in the form of request records. At the end of a year, a separate program (HAMR) extracts from this master-file a physically distinct holdings file composed of the MARC record for each Library of Congress card number and the corresponding holdings data (from the request form) for that record by participating institutions. This file is further massaged to eliminate unnecessary cataloging data in the MARC records and to access it by Library of Congress card numbers. The new programs are described in the next chapter and are technically detailed in Appendix IV.

3.3 COST ANALYSIS OF THE HOLDINGS FILE PROCESSING PROGRAMS (HFPP)

The cost analysis presented is an estimate of future production costs for HFPP. Because the service centers used by Inforonics, Inc. have differing charge setups, we have based the following cost breakdown on average charges for existing programs and estimated charges for the new programs that have not yet been run under the production system.

There is no difference in the cost of HFPP for those libraries that want cataloging products and those that only want to be included in the holdings file without getting cataloging products. This is because the cost incurred is not due to creating the holdings record (which is counterbalanced by the economies of record blocking used in HAMP), but in holding the record on file, thereby making a larger file to search and sort, and in the creation of a printed union listing. Since the holding of the record on the master-file and the printing are shared by both possible users, the cost is the same, and, of course, there is no HFPP charge for those who do not want to be included in the holdings file but do wish to procure cataloging products.

The following cost analysis is based on the same projection figures used in the final report for CLR-443, for continuity in the overall view of the Network's development. Thus, we assume 100,000 MARC records for a year's master file and 20 libraries in the Network with 100 requests a week per library.

3.3.1 HAMP Cost Breakdown:

HAMP is the replacement of SMERGE in the cataloging products subsystem and will cost approximately the same, \$700 for a 5 tape file (100,000 MARC records), or \$140 per tape (see final report for CLR-443 for the \$700 breakdown). At nominal data density

5 tapes ≅ 10,000,000 computer data words

1 tape ≅ 2,000,000 computer data words

length of one holdings record ≅ 15 computer words

$\begin{array}{r} 133{,}333 \\ 15\,\overline{)2{,}000{,}000} \end{array}$ holdings records per magnetic tape

$\begin{array}{r} \$\quad .001 \\ 133{,}333\ \ \overline{)\$140.000} \end{array}$ cost of one holdings record added to the master file for use by HAMP per week.

The cost of holdings records increases each week with the increase in matched requests. Assuming 85% matched requests out of 100 average requests per week for each of the 20 libraries, the cost for one week's holdings records per library is:

$$\begin{array}{r} \$.001 \\ \text{x}85 \\ \hline \$.085 \end{array}$$

For 20 libraries, one week's holdings cost is:

$$\begin{array}{r} \$.085 \\ \text{x}20 \\ \hline \$1.700 \end{array}$$

The cumulative cost of one library's holdings for any given period is \$0.001 per week for each record, new or old. For a group of (L) libraries, each of which start with no holdings and then add (R) records per week, for a period of (N) weeks, the cumulative group cost (C) for this period is:

$$C = \$0.001 \sum_{x=1}^{N} LRX = \$0.001\ LR\left(\frac{N^2+N}{2}\right)$$

For one library, adding 85 records per week for one year, this is:

$$C = \$0.085\ (1378) = \$117.13$$

For 20 libraries, at the same rate of additions for one year:

$$C = \$2342.60$$

The cost (C') of one library holding a back file of accumulated records (A = number of records) for N' weeks is:

$$C' = \$0.001\ AN'$$

For the accumulation rate in question, the first year's accumulation of one library, if held for a second year would be:

$$C' = \$0.001(4420)52 = \$229.84$$

which does not include the cost of records added during the second year. Were records to be held a second year, the total cost per library would be:

$$C + C' = \$117.13 + \$229.84 = \$346.97$$

A 2-year holdings file is seen to be almost 3 times as expensive as a 1-year holdings file, and this is the rationale for limiting the tape-based holdings file to 1 year, extracting the older data to an archive file.

3.3.2 HAMR Cost Breakdown:

Average cost of reproducing a whole tape = \$22 to \$28, ≈	\$25.00
Average cost of reading a tape = ½ reproducing =	12.50
Average cost of reading 5 tapes = \$12.50 x 5 =	62.50
Estimated CPU cost ≅	10.00
	\$72.50

Estimated output to disc of one library's holdings (4,420 records) ≅ \$2.50

The cost of the output is variable, dependent upon the number of libraries included in the printed catalog; therefore, the total cost of HAMR is:

$$\$72.50 + (\$2.50 \cdot X), \text{ where } X = \text{number of libraries}$$

For one library:	\$72.50	For 20 libraries:	\$72.50
	+2.50		+50.00
	\$75.00		\$122.50

3.3.3 Sort Key Generator Cost:

The average cost per record to produce a sort key is $.005.

For one library's holdings: 4420

x$.005

$22.10

For 20 libraries 'holdings: $22.10

x 20

$442.00

3.3.4 Sort Cost:

The average cost per record in the current SORT program is $.018.

For one library's holdings: 4420

x$.018

$79.56

For 20 libraries 'holdings: $79.56

x 20

$1591.20

3.3.5 UNLIST/DEVIL Cost:

We estimate that UNLIST/DEVIL will cost approximately $.002 per record.

For one library's holdings: 4420

x$.002

$8.84

For 20 libraries'holdings: $8.84

x 20

$176.80

3.3.6 PRINTER and Lineprinter Listing Cost:

The average cost per record is $.002.

For one library's holdings: $8.84

For 20 libraries' holdings: $176.80

3.3.7 Estimated Cost Of Layout Preparation:

Assuming an average of 2½ to 3 lines a record and approximately 60 lines a page, 20 records may be printed on a three column page.

$\frac{4420}{20}$ 200 pages for each library's holdings

labor estimated at $2.60 an hour for 16 hours: $41.60
materials: 10.00
$51.60
to do the layout for one library's union list

For 20 libraries: $51.60
x 20
$1032.00

3.3.8 Cost Projection Totals:

Unit	1 library (4,420 recs)	20 libraries (88,400 recs)
HAMP	$117.13	$2342.60
HAMR	75.00	122.50
SORT KEY GEN.	22.10	442.00
SORT	79.56	1591.20
UNLIST/DEVIL	8.84	176.80
PRINTER	8.84	176.80
Layout	51.60	1032.00
Totals*	$363.07	$5883.90
average cost/rec. for each library	$0.082	$0.067

* totals exclude the printing costs because there are too many means of final printing to estimate an average cost.

3.3.9 Cost Commentary:

The cost projection detailed above is a conservative estimate in the absence of running experience. It should be noted that no participant is limited to 100 requests a week; this figure is based on current request averages and is easy for calculation. Because of the 2.5 expansion factor for the holdings file, there should be no change in the cost figures until such a time as twenty participating libraries average 250 requests/week for each institution. At this point, five tapes are no longer sufficient, and new costs for a six tape master file would have to be calculated.

4. DESCRIPTION OF HOLDINGS FILE PROCESSING PROGRAMS

The Holdings File Processing Programs (HFPP) are a series of programs that were designed to fit the flow of the current cataloging products subsystem (see Flow Chart #1). Thus all activities, be they for cataloging products or inclusion into the union holdings or both, begin at the same point, with the input to the system of requests from participating institutions and the week's new MARC II records.

In the existing cataloging products subsystem, a program called SMERGE matches the requests and MARC records and outputs the necessary data for the production of cards, book pocket labels, and book labels. A new program, HAMP, described below, replaces SMERGE, generating cataloging products as well as creating the holdings file. Two programs that are part of entry into the system were altered to extend the existing system for HFPP. The Request Verifier was set up to accept and verify the control codes that decide holdings inclusion or exclusion: N for no holdings of this record wanted; R for replacing old holdings of this record; E to eliminate the holdings records that match this request; H to indicate that this is a holdings record for which products have been received; and a blank to request both cataloging products and holdings record. The Sort Key Generator also had to be modified to accept the combining functions and subsystem handling for use with HAMR, but this was identified as a bug in the program that, while it did not effect SMERGE, would impede the proper operation of HAMR.

4.1 HOLDINGS AND MARC PROCESSOR (HAMP)

HAMP is the primary processing program and performs the following functions:

a) Create a holdings record when the control code on a request indicates to do so.

b) Update holdings records.

c) Update MARC records.

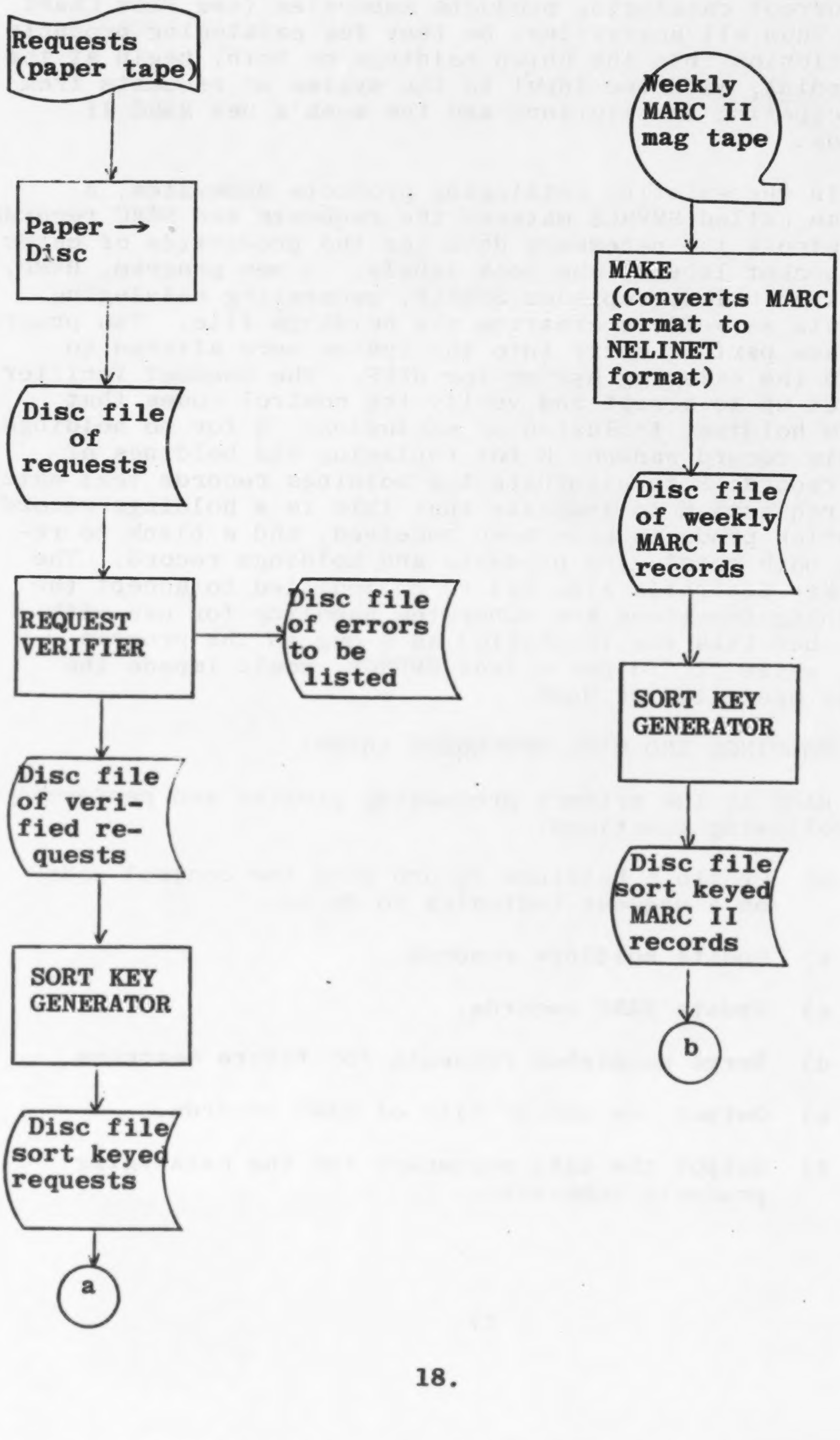
d) Merge unmatched requests for future searches.

e) Output new master file of MARC records.

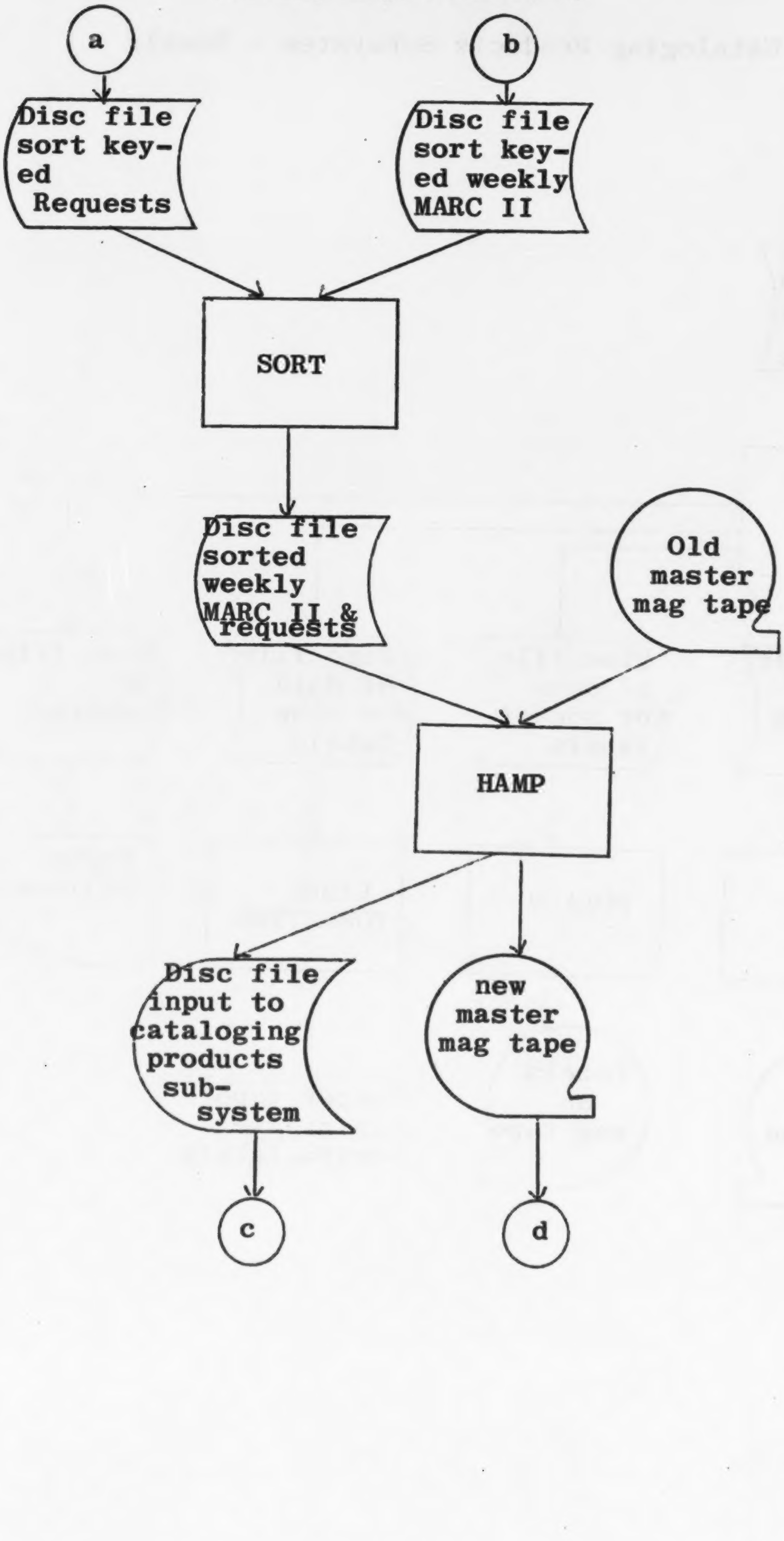
f) Output the data necessary for the cataloging products subsystem.

NELINET SYSTEM Flow Chart #1

(Weekly Input)

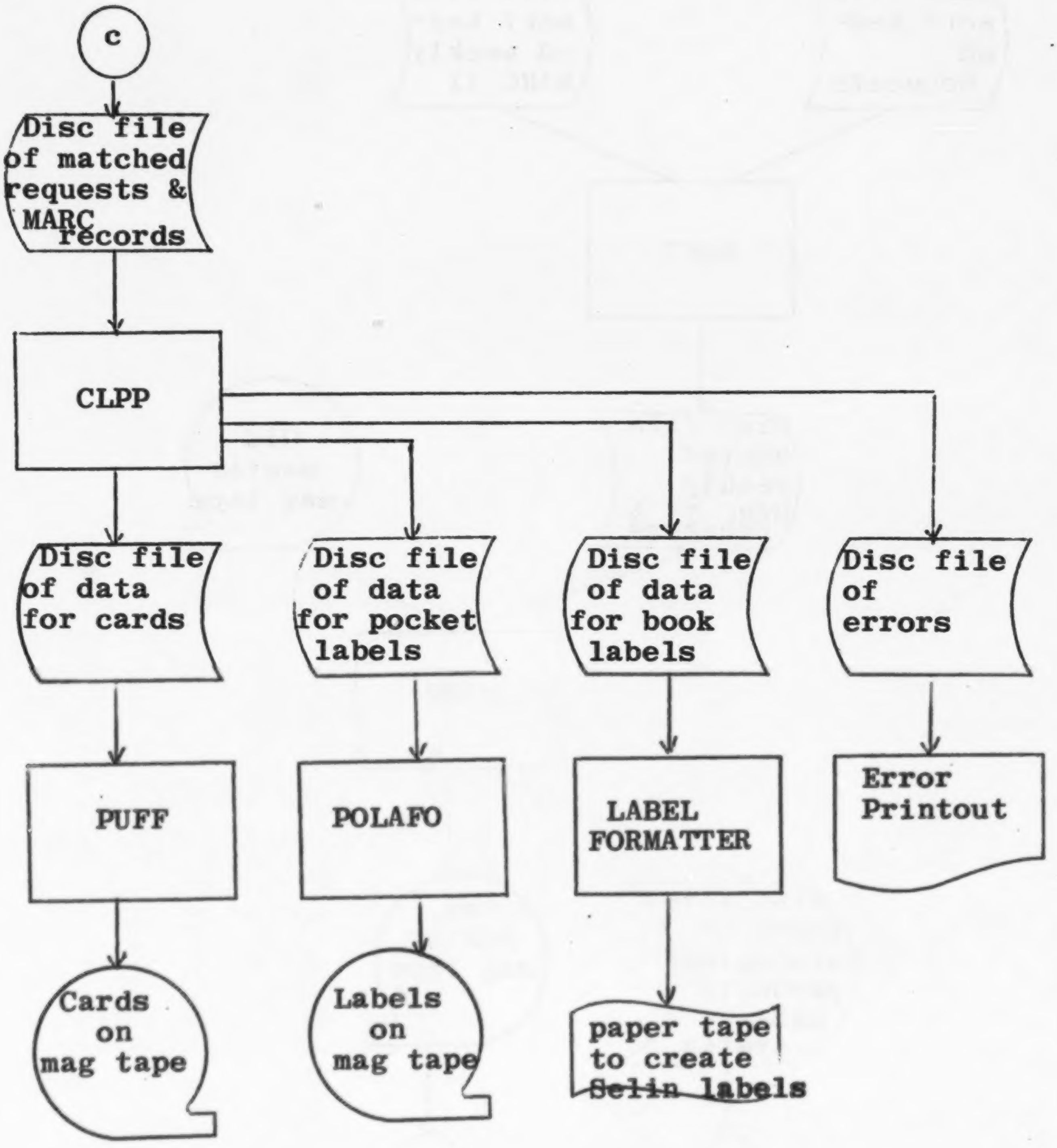

Requests (paper tape)
Paper → Disc
Disc file of requests
REQUEST VERIFIER
Disc file of errors to be listed
Disc file of verified requests
SORT KEY GENERATOR
Disc file sort keyed requests
a
Weekly MARC II mag tape
MAKE (Converts MARC format to NELINET format)
Disc file of weekly MARC II records
SORT KEY GENERATOR
Disc file sort keyed MARC II records
b

NELINET SYSTEM
(Weekly Input cont'd.)


a
b
Disc file sort keyed Requests
Disc file sort keyed weekly MARC II
SORT
Disc file sorted weekly MARC II & requests
Old master mag tape
HAMP
Disc file input to cataloging products subsystem
new master mag tape
c
d

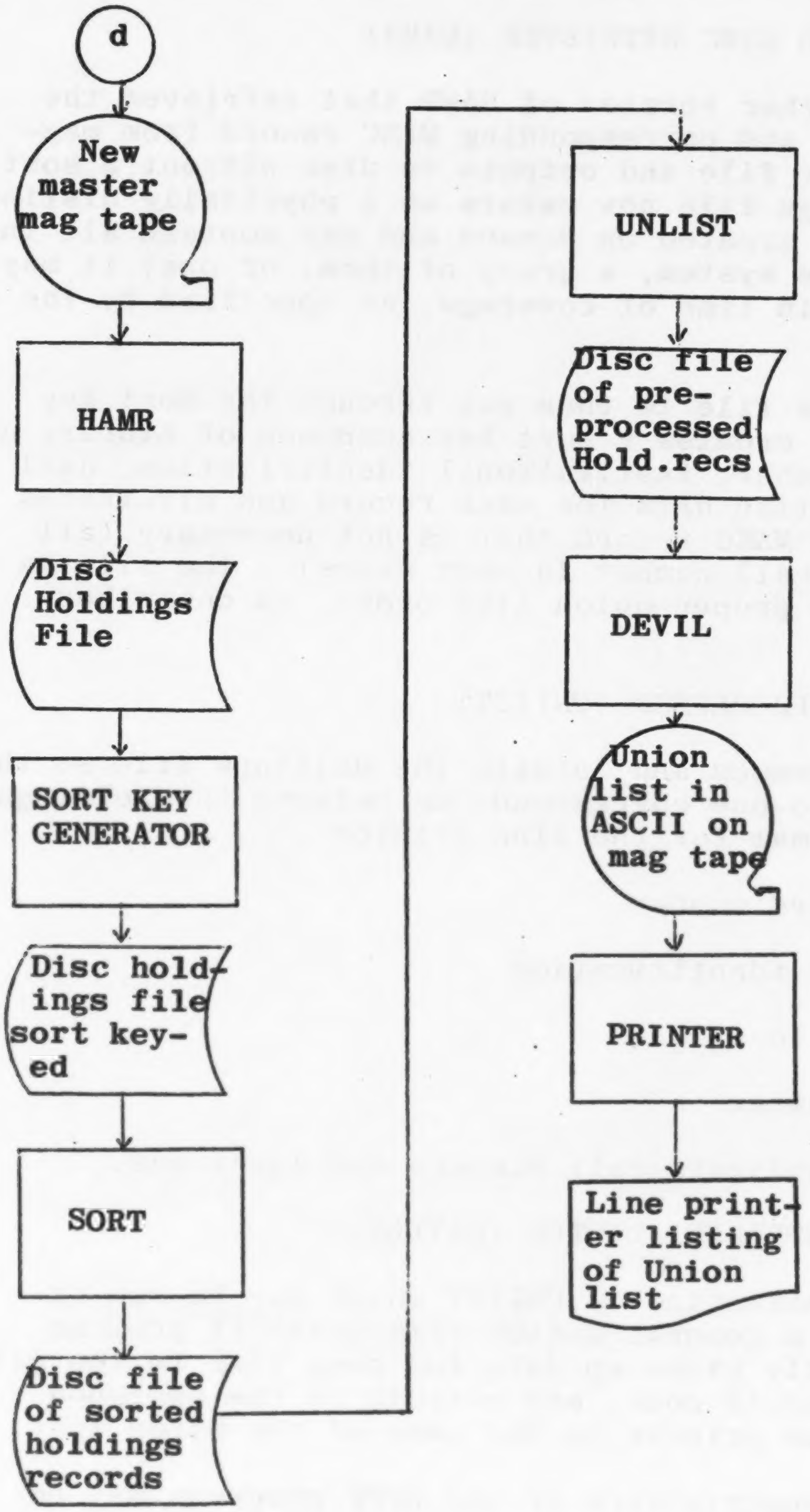
NELINET SYSTEM

Cataloging Products Subsystem - Weekly


c
Disc file of matched requests & MARC records
CLPP
Disc file of data for cards
Disc file of data for pocket labels
Disc file of data for book labels
Disc file of errors
PUFF
POLAFO
LABEL FORMATTER
Error Printout
Cards on mag tape
Labels on mag tape
paper tape to create ~~Selin~~ labels

NELINET SYSTEM

Union List Subsystem - on demand and annually


d
New master mag tape
HAMR
Disc Holdings File
SORT KEY GENERATOR
Disc holdings file sort keyed
SORT
Disc file of sorted holdings records
UNLIST
Disc file of preprocessed Hold.recs
DEVIL
Union list in ASCII on mag tape
PRINTER
Line printer listing of Union list

The master file contains both the updated holdings records and the updated MARC records after a HAMP run.

4.2 HOLDINGS AND MARC RETRIEVER (HAMR)

HAMR is another version of HAMP that retrieves the holdings records and corresponding MARC record from magnetic tape master file and outputs to disc without a sort key. The holdings file now exists as a physically distinct file. It may be created on demand and may contain all institutions in the system, a group of them, or one; it may also be limited in time of coverage, as specified by the requestor.

The holdings file is then put through the Sort Key Generator, which creates a sort key composed of Library of Congress card number, institutional identification, call number, and location data for each record and eliminates that data on the MARC record that is not necessary (all except the L.C. call number in most cases). The file is then sorted into proper union list order, as described below.

4.3 UNION LIST PROCESSOR (UNLIST)

UNLIST processes and formats the Holdings file so that there is a one-to-one correspondence between the holdings data and the format for the line printer:

a) L.C. card number

b) Library identification

c) Branch location

d) Call number

It eliminates duplicate call numbers and locations.

4.4 DEVICE INDEPENDENT LISTER (DEVIL)

DEVIL, a subroutine of UNLIST which may be run independently, is a general Master File-to-ASCII program which sequentially picks up data for each item in the file, converts it to ASCII code, and outputs to the assigned device, the line printer in the case of the union list.

Technical descriptions of the HFPP programs may be found in Appendix IV.

5. FUTURE APPLICATIONS OF UNION CATALOG CAPABILITY

The union catalog capability developed under this contract is basically a system for the collection, updating, and subsequent output of local data sets that are identified with the institution originating the data and that have reference links to a central data file.

Viewed in these general terms, the possible extensions of the system to specific new applications become more apparent. We list below some of these applications.

5.1 EXPANSION OF HOLDINGS FILE VIA LOCAL INPUT OF RETROSPECTIVE DATA

The utility of a holdings file increases with its coverage. The growth of the basic MARC II file, future MARC-RECON data, and future MARC foreign language coverage, will indirectly cause the system's coverage to increase, since more cataloging data requests will result in a larger holdings file. For more complete coverage however, the addition of local holdings data may be desired, whether or not there exists a corresponding catalog entry in the MARC file. The present system can be readily adapted to this end.

5.2 PRINTED 'NEW HOLDINGS' LISTS FOR REGIONAL ACQUISITION ACTIVITIES

The production of traditional union catalogs is often considered a yearly or half-decade event. The capability to provide fast computer output of new union lists, either on a comprehensive basis or on a "new holdings" basis, makes possible the more frequent publication of union catalogs, and further could provide an aid to balanced regional acquisitions, by making available the new holdings list of regional institutions.

5.3 SUBJECT-SELECTIVE AND AUTHOR-TITLE CATALOGS

The present union catalog capability is limited to producing entries in L.C. Card Number order. Because the Holdings File references catalog records in the MARC II file, the system could be expanded to select items from both files, arrange these in any desired order, and provide ordered listings by subject heading, L.C. Class Number, author, title, or other selected data element.

5.4 UNION CATALOG FOR SERIALS

Expansion to serials holdings would be relatively direct, and for widest application should include a subsystem for serials check-in, vendor notification of overdue issues, etc.

5.5 ON-LINE SEARCH OF UNION CATALOG

When the system goes on-line and the use of remote terminals in libraries is more extensive, it will be possible to provide on-line search access to the machine-form union catalog for a variety of uses. Two obvious applications are search in support of inter-library loans, and search in support of acquisitions.

5.6 AUTOMATED INTER-LIBRARY LOAN SYSTEM

A logical extension of on-line search, is that of automated search and accounting in support of inter-library loans. It would be possible for such a system to accept inter-library loan requests, automatically search the machine-form union catalog for occurrences of the item, determine whether or not the item was available for inter-library loan, select the closest institution where it was available, prepare shipping forms for that institution, accept log-in notification when the item arrived, and prepare return reminders when the loan period expired. It would further be possible to automatically balance the demands on individual institutions, and avoid the common problem of larger institutions getting the majority of loan requests. In short, it would be possible to take much of the manual effort and paper work out of inter-library loan activities and thus encourage regional sharing to a greater degree.

5.7 AUTOMATED CIRCULATION SYSTEM

As in the automated inter-library loan system, an automated regional circulation system could be based on increasing the data content of the basic holdings record in the machine-form union catalog. One benefit of a regional approach to circulation is that user requests for items that are in circulation locally, can be instantly converted to specific inter-library loan requests.

5.8 REGIONAL MANAGEMENT INFORMATION SYSTEM

As the overall machine-based activities of the network expand, it becomes necessary to monitor this activity by machine so that accurate accounting of services and measures of systems performance can be obtained for improved network management. Again, this is an instance where the automatic collection of local data sets (as is performed now in the case of the holdings records) can provide the basis for services of much wider scope. A logical extension to this is the addition of local management data so that both institutional and network management can be served via an integrated regional Management Information System.

5.9 APPROACH TO IMPLEMENTATION

The implementation of these future applications depends on an orderly progression of new development work that builds upon the existing system. Such developments are discussed in the section on recommendations that follows.

6. RECOMMENDATIONS

6.1 ON-LINE UNION CATALOG

The most immediate recommendation is to implement the machine form catalog in an on-line system. This is a necessary step for the education of the library community. An automated system must be viewed by libraries as more than a one-shot printing job for a set of catalog cards or a union list. Librarians need to become conscious of their machine file as an active, useful file. The accuracy of the holdings file is the basis of future products and services, and such accuracy may only be attained by having easy, direct access to the file via terminals in each library. On-line access would also increase the use of the file in two areas:

1. An automated inter-library loan system, with the inclusion of the necessary location-versus-availability information and a new program.

2. Experimental service and cost comparison of the uses of a machine catalog versus the traditional printed/card catalog.

6.2 QUERY AND RESPONSE TECHNIQUES

As part of creating an on-line catalog there must be parallel research into the design of a query and response language to be used by the librarians, and, eventually, the scholars and students on the system. This should include experimentation with differing terminals to determine which is most useful and economic for a library situation.

6.3 INCLUSION OF NON-MARC DATA INTO UNION CATALOG

At present the NELINET data base is restricted to weekly MARC II tapes which cover all current English language acquisitions by the Library of Congress. This is to be enlarged to all Roman-alphabet language acquisitions in the near future. Although this data base does cover a large percentage of most libraries' acquisitions, it does not begin to cover their entire collections. The Library of Congress has announced RECON, a project to convert retrospective data to MARC II form, but this has not been begun for distribution and may not start in the near future.

The time and cost involved in keying a whole collection into the very complicated MARC format is an overwhelming prospect for an individual library, or, indeed, a network. However, since the use of a union catalog is proportionate to its size, there must be some means of including non-MARC data with the holdings file. This will involve very basic research into the area of bibliographic machine format as well as possible further research into file organization and access.

6.4 UNION CATALOG FOR SERIALS

Now that NELINET has a means for collecting holdings records for monographs, it is a natural step to extend the holdings file to include serials. The basic house keeping routines for a machine form union catalog have been developed. What would be necessary to collect serials holdings is the design of a serials record sufficiently compatible with the MARC format to be included in the same holdings file as the monographic holdings records.

6.5 STUDY OF RETRIEVAL TECHNIQUES

Presently, access to the master file and the holdings file is restricted to one means, the Library of Congress card number. NELINET will have to be prepared for the traditional access by author, title, and subject data when the system becomes an on-line one. This will require three developments:

1. Directory design.
2. Remote retrieval procedures.
3. Search code design.

This work is imperative if full use is to be made of the data base.

6.6 MANAGEMENT INFORMATION SYSTEM

Holdings file capability increases the services and coverage of NELINET to the point that it becomes necessary to start the design of a long range management information system (MIS) both for the management of the Network and as a tool for the participating libraries. NELINET management needs the following information:

1. Overall systems cost figures.
2. Records of services provided to each participating institution.
3. Utilization data on equipment and special programs.
4. Time records of functions performed as a check to system efficiency.
5. A cost accounting system that is fair to all Network participants.
6. Data on the down-time of the system and peripherals as a check to system reliability.

Management information that would be desired by the participating institutions includes:

1. Geographic distribution of holdings by subjects.
2. Regional growth patterns.
3. Information on departmental acquisitions.
4. Status of purchasing funds.
5. Projections of shelf space requirements.
6. Data on inter-library loan activity.
7. Circulation records.
8. Records of Network services and costs.

There are, therefore, two inter-related components of a network-oriented MIS. One component would result from automatic programmed monitoring of on-going network activities, and manipulating this data into useful information for network management and library management. A second component would result from input of additional local library operations data that cannot currently be automatically captured.

APPENDIX I

PRINTOUT OF MACHINE-FORM UNION CATALOG

The 10 pages following are a sample printout of the NELINET machine-form union catalog. The data here is a portion of the holdings file created during one recent weekly processing run. This sample data was output on line printer; line printer pages were photo-reduced to 80% linear size; and made up three line printer pages to one catalog page.

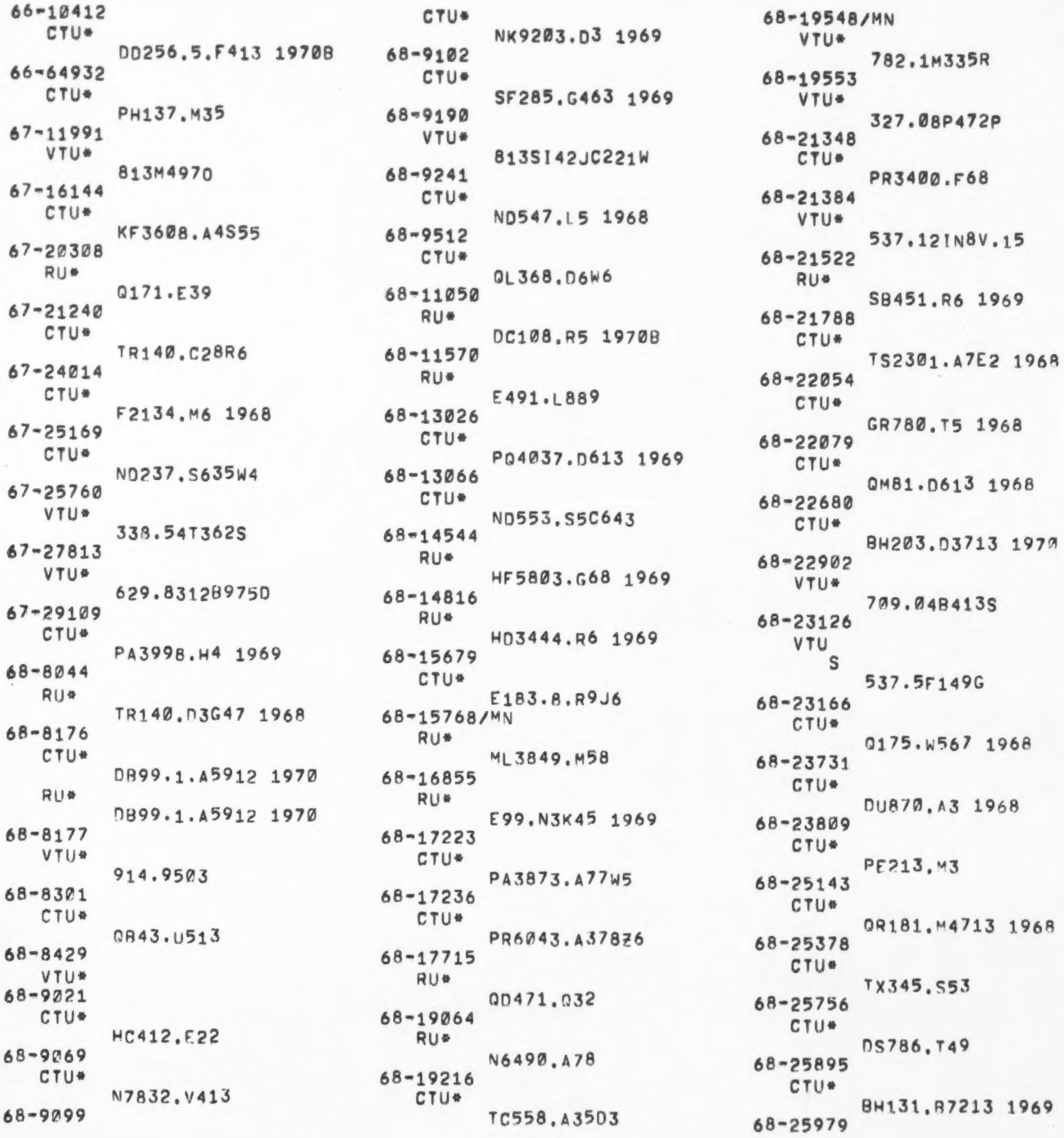
The output format is variable by program setup, and of course by variation in printed page design and makeup. The format of the sample is representative of a three column line printer format suited to 8½ x 11 page size. It is obvious that a greater reduction in type size and a greater use of white space could be obtained for the economic printing of a complete union catalog. The machine-form catalog could also be used as input to commercial computer composition and typesetting services for typographic quality output.

In this sample, entries are ordered by L.C. Card Number and an asterisk after the library identification code (NUC code) indicates that the item is held in the main library. The printout includes branch locations where applicable and L. C. Call Number or local Call Number if supplied by the library. In one case, it will be noted that no call number is given; this represents a transient condition of the holdings record wherein the library has been requested by the program to supply a local call number, not yet received, to substitute for an apparent null entry in the MARC record. One main entry card is sent to the library in this case for their examination.

At any time, the libraries may add to, modify, or delete their holdings record for a particular work.

NELINET

printout of machine-form union catalog



```
66-10412
    CTU*
         DD256.5.F413 1970B
66-64932
    CTU*
         PH137.M35
67-11991
    VTU*
         813M4970
67-16144
    CTU*
         KF3608.A4S55
67-20308
    RU*
         Q171.E39
67-21240
    CTU*
         TR140.C28R6
67-24014
    CTU*
         F2134.M6 1968
67-25169
    CTU*
         ND237.S635W4
67-25760
    VTU*
         338.54T362S
67-27813
    VTU*
         629.8312B975D
67-29109
    CTU*
         PA3998.H4 1969
68-8044
    RU*
         TR140.D3G47 1968
68-8176
    CTU*
         DB99.1.A5912 1970
    RU*
         DB99.1.A5912 1970
68-8177
    VTU*
         914.9503
68-8301
    CTU*
         QB43.U513
68-8429
    VTU*
68-9021
    CTU*
         HC412.E22
68-9069
    CTU*
         N7832.V413
68-9099
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    CTU*
         NK9203.D3 1969
68-9102
    CTU*
         SF285.G463 1969
68-9190
    VTU*
         813SI42JC221W
68-9241
    CTU*
         ND547.L5 1968
68-9512
    CTU*
         QL368.D6W6
68-11050
    RU*
         DC108.R5 1970B
68-11570
    RU*
         E491.L889
68-13026
    CTU*
         PQ4037.D613 1969
68-13066
    CTU*
         ND553.S5C643
68-14544
    RU*
         HF5803.G68 1969
68-14816
    RU*
         HD3444.R6 1969
68-15679
    CTU*
         E183.8.R9J6
68-15768/MN
    RU*
         ML3849.M58
68-16855
    RU*
         E99.N3K45 1969
68-17223
    CTU*
         PA3873.A77W5
68-17236
    CTU*
         PR6043.A378Z6
68-17715
    RU*
         QD471.Q32
68-19064
    RU*
         N6490.A78
68-19216
    CTU*
         TC558.A35D3
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68-19548/MN
    VTU*
         782.1M335R
68-19553
    VTU*
         327.08P472P
68-21348
    CTU*
         PR3400.F68
68-21384
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         537.12IN8V.15
68-21522
    RU*
         SB451.R6 1969
68-21788
    CTU*
         TS2301.A7E2 1968
68-22054
    CTU*
         GR780.T5 1968
68-22079
    CTU*
         QM81.D613 1968
68-22680
    CTU*
         BH203.D3713 1970
68-22902
    VTU*
         709.04B413S
68-23126
    VTU
      S
         537.5F149G
68-23166
    CTU*
         Q175.W567 1968
68-23731
    CTU*
         DU870.A3 1968
68-23809
    CTU*
         PE213.M3
68-25143
    CTU*
         QR181.M4713 1968
68-25378
    CTU*
         TX345.S53
68-25756
    CTU*
         DS786.T49
68-25895
    CTU*
         BH131.B7213 1969
68-25979
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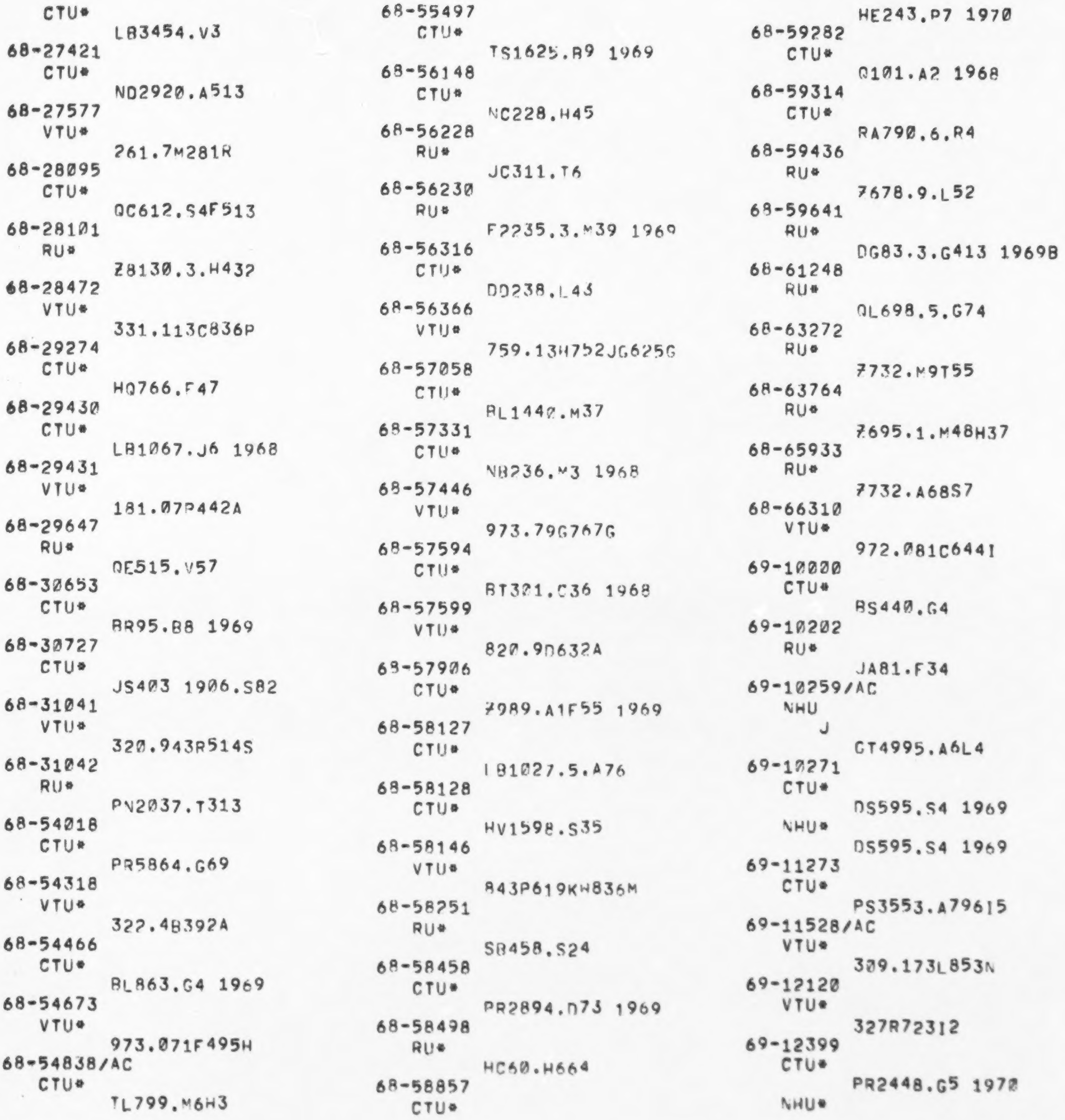
NELINET



printout of machine-form union catalog

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     CTU*
              LB3454.V3
68-27421
     CTU*
              ND2920.A513
68-27577
     VTU*
              261.7M281R
68-28095
     CTU*
              QC612.S4F513
68-28101
     RU*
              Z8130.3.H432
68-28472
     VTU*
              331.113C836P
68-29274
     CTU*
              HQ766.F47
68-29430
     CTU*
              LB1067.J6 1968
68-29431
     VTU*
              181.07P442A
68-29647
     RU*
              QE515.V57
68-30653
     CTU*
              BR95.B8 1969
68-30727
     CTU*
              JS403 1906.S82
68-31041
     VTU*
              320.943R514S
68-31042
     RU*
              PN2037.T313
68-54018
     CTU*
              PR5864.G69
68-54318
     VTU*
              322.4B392A
68-54466
     CTU*
              BL863.G4 1969
68-54673
     VTU*
              973.071F495H
68-54838/AC
     CTU*
              TL799.M6H3
```

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68-55497
     CTU*
              TS1625.B9 1969
68-56148
     CTU*
              NC228.H45
68-56228
     RU*
              JC311.T6
68-56230
     RU*
              F2235.3.M39 1969
68-56316
     CTU*
              DD238.L43
68-56366
     VTU*
              759.13H752JG625G
68-57058
     CTU*
              BL1440.M37
68-57331
     CTU*
              NB236.M3 1968
68-57446
     VTU*
              973.79G767G
68-57594
     CTU*
              BT301.C36 1968
68-57599
     VTU*
              820.9D632A
68-57906
     CTU*
              Z989.A1F55 1969
68-58127
     CTU*
              LB1027.5.A76
68-58128
     CTU*
              HV1598.S35
68-58146
     VTU*
              843P619KH836M
68-58251
     RU*
              SB458.S24
68-58458
     CTU*
              PR2894.D73 1969
68-58498
     RU*
              HC60.H664
68-58857
     CTU*
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              HE243.P7 1970
68-59282
     CTU*
              Q101.A2 1968
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68-59436
     RU*
              Z678.9.L52
68-59641
     RU*
              DG83.3.G413 1969B
68-61248
     RU*
              QL698.5.G74
68-63272
     RU*
              Z732.M9T55
68-63764
     RU*
              Z695.1.M48H37
68-65933
     RU*
              Z732.A68S7
68-66310
     VTU*
              972.081C644I
69-10000
     CTU*
              BS440.G4
69-10202
     RU*
              JA81.F34
69-10259/AC
     NHU
       J
              CT4995.A6L4
69-10271
     CTU*
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     NHU*
              DS595.S4 1969
69-11273
     CTU*
              PS3553.A79615
69-11528/AC
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69-12399
     CTU*
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     NHU*
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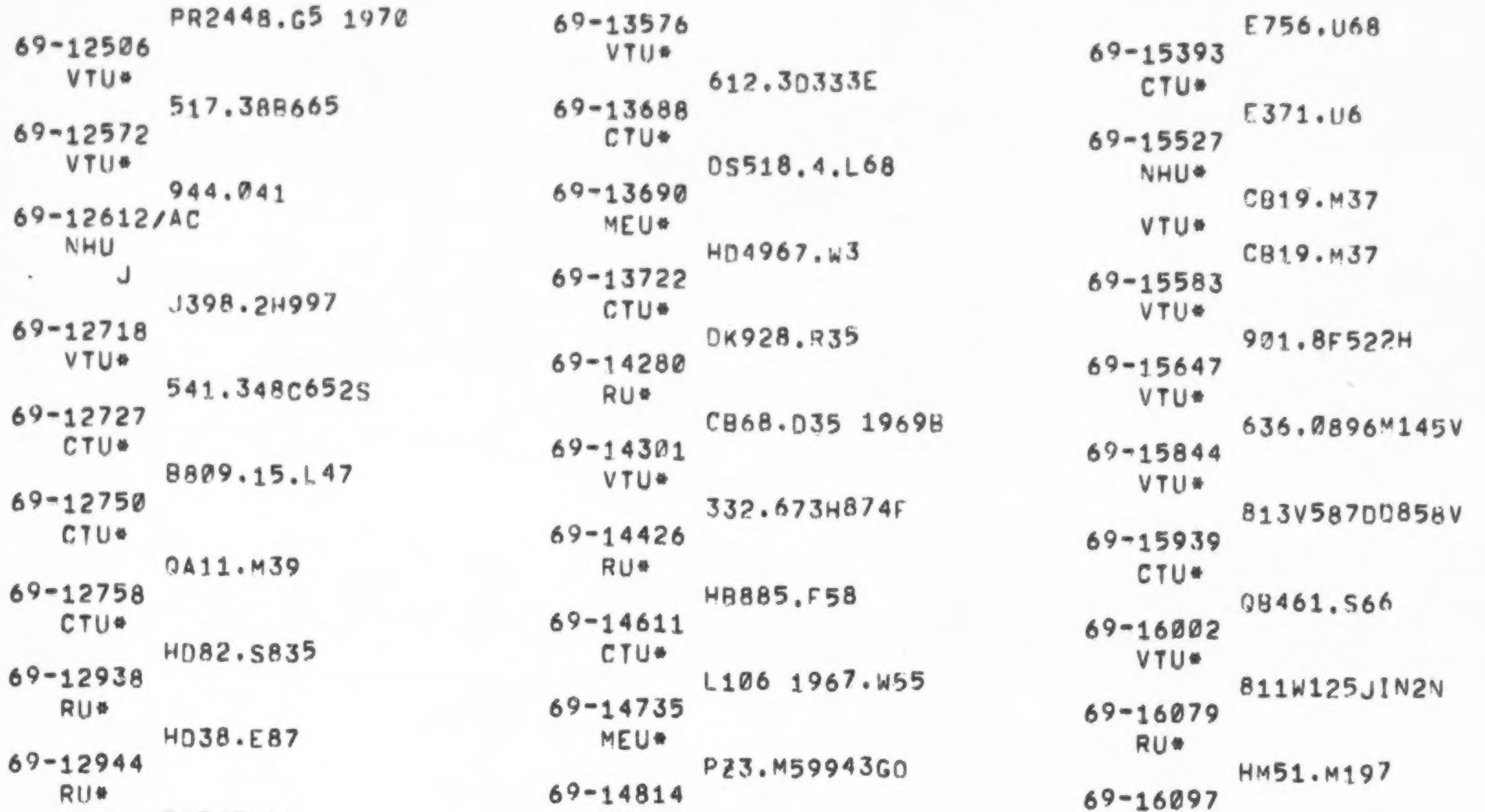

NELINET

printout of machine-form union catalog

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69-12506
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69-12572
    VTU*
              944.041
69-12612/AC
    NHU
        J
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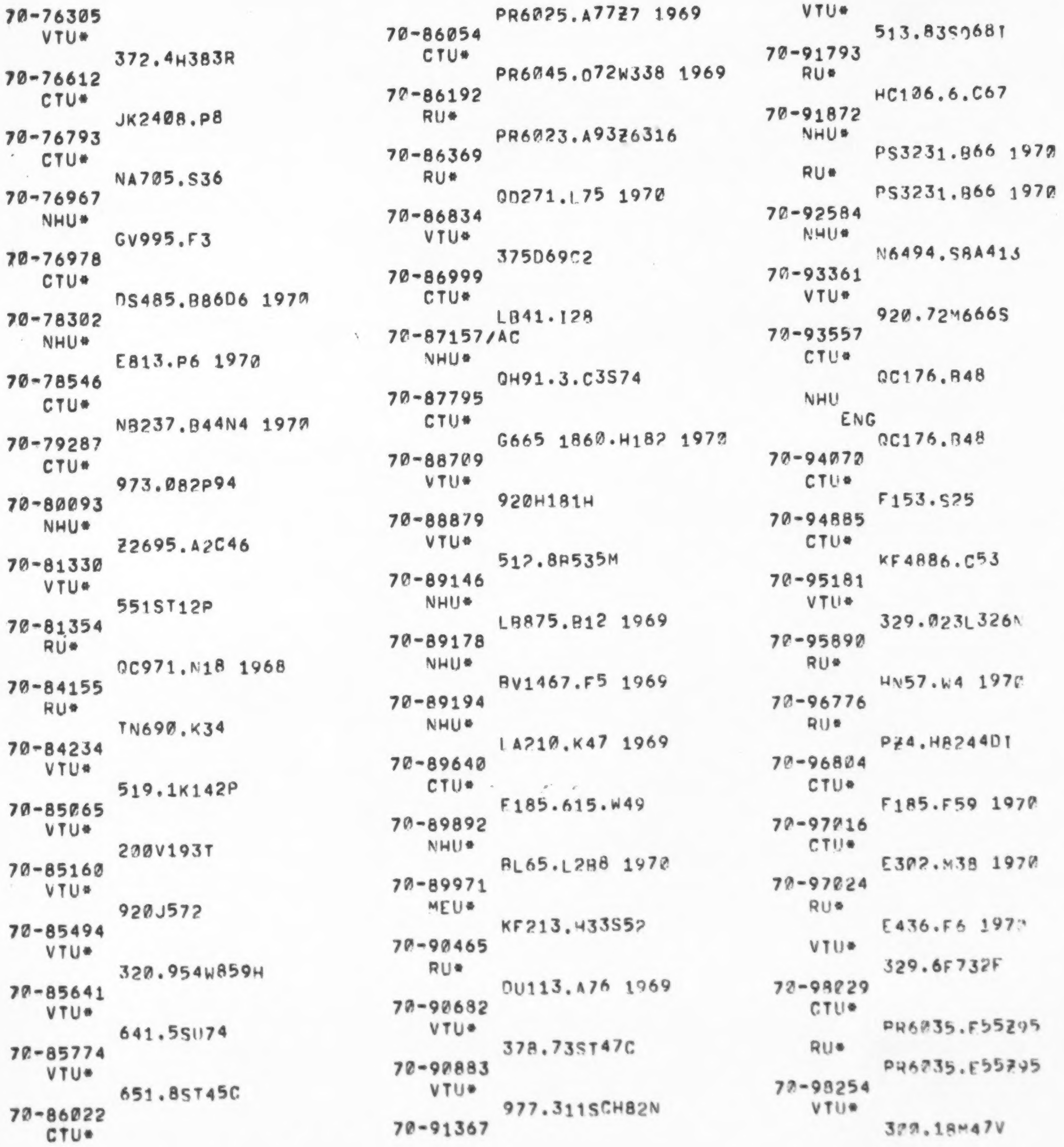

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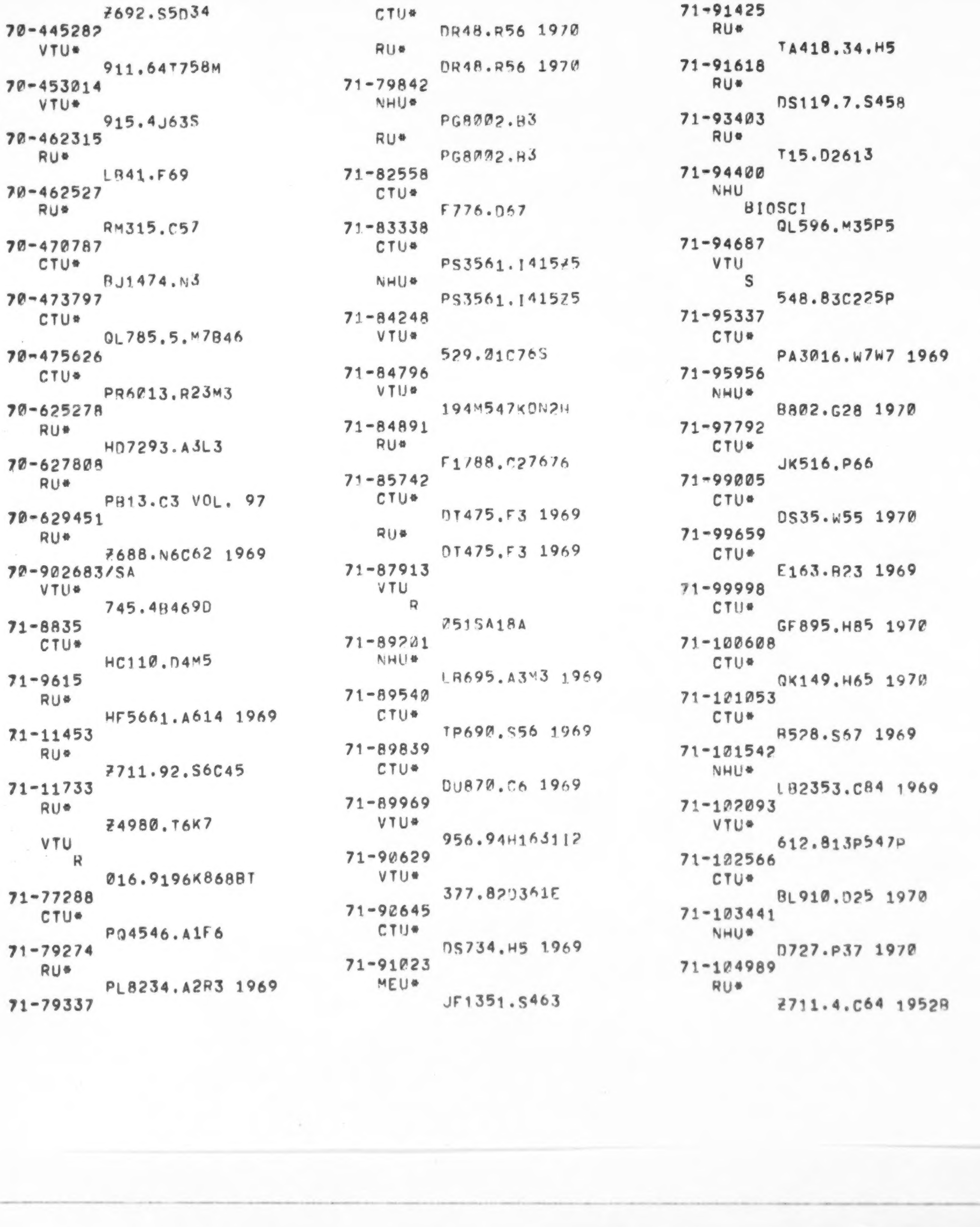

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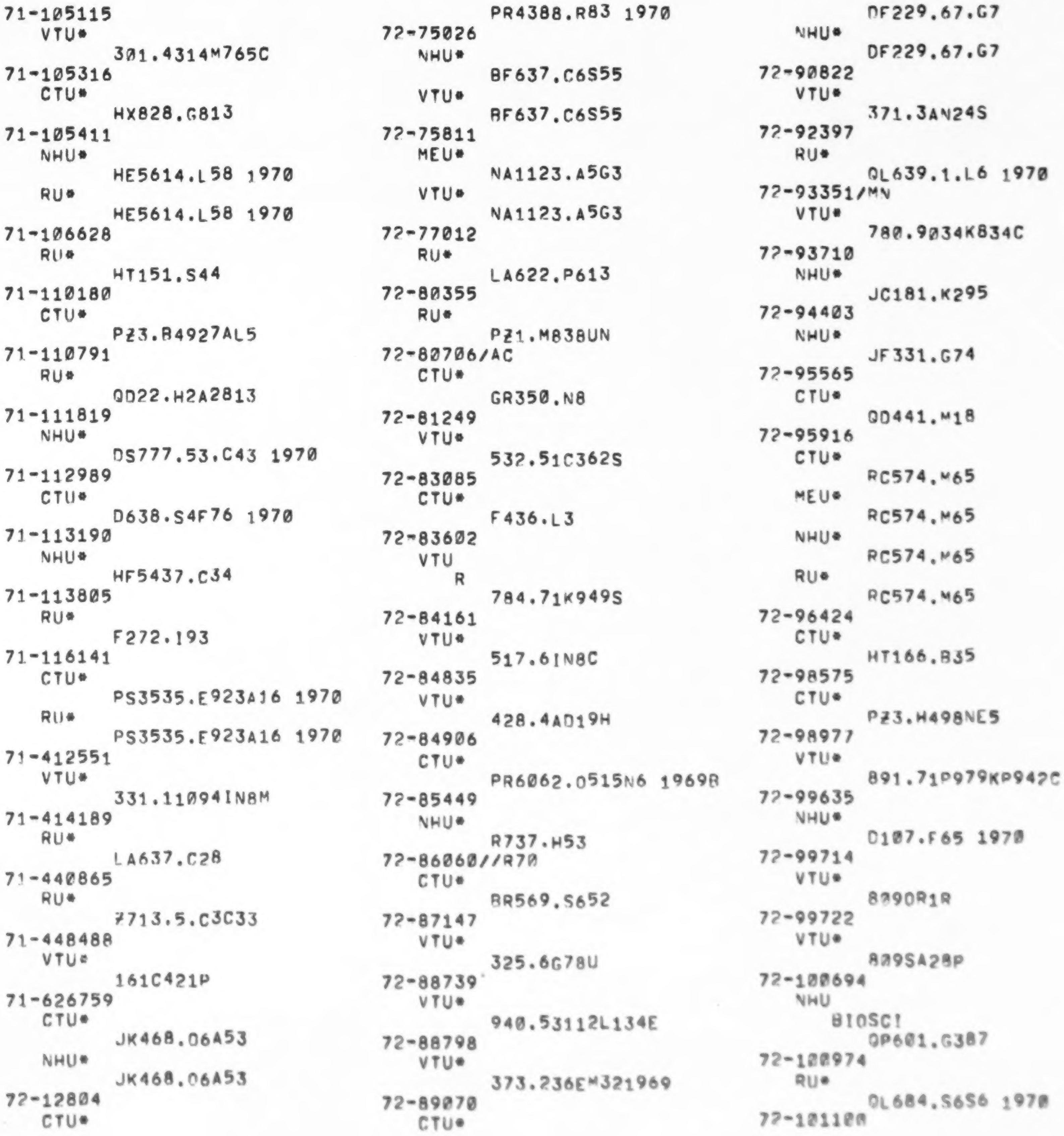

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NELINET

printout of machine-form union catalog

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            E748.M143M3
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  73-105555
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APPENDIX II

ANALYSIS OF THE CHANGES MADE BY THE NELINET LIBRARIES IN LIBRARY OF CONGRESS CATALOGING COPY

by

Ann T. Curran

ANALYSIS OF THE CHANGES MADE BY THE NELINET LIBRARIES IN LIBRARY OF CONGRESS CATALOGING COPY

At present, the NELINET card production programs process the Library of Congress cataloging data on the MARC tapes and allow for one change only -- the use of a local call number instead of the call number established at the Library of Congress. In the future it may be desirable to increase the capability to modify the Library of Congress cataloging data in the MARC record with other changes in the bibliographic data that a library may wish to make. A library may wish to (1) add bibliographic data, e.g., add a note, (2) replace bibliographic data, e.g., substitute a different imprint date for the one in the MARC record, or (3) delete bibliographic data, e.g., delete a series added entry.

1. PROCEDURE

In order to have some background information on the quantity and types of changes that the NELINET libraries make to Library of Congress cataloging copy, the Universities of Connecticut, Maine, New Hampshire, Rhode Island, and Vermont analyzed their present processing practices for one week. Before filing their shelf list cards into their shelf list, each library first separated the Library of Congress cataloging copy from original cataloging. The Library of Congress cataloging copy was then counted and examined and the following was recorded:

1. The data fields that were changed on each card. This was done according to the MARC II format for identifying or tagging variable field data.

2. Whether each change involved an addition, replacement, or deletion of data.

3. Whether each change involved changing the entire field - i.e., all the subfields in the field (as defined in the MARC II format) -- or just a partial change - i.e., one or some of the subfields were not changed.

4. When the change was a partial change, the particular subfield(s) that were changed.

Instructions and illustrative examples were sent to each library. These were later reviewed with an Inforonics staff member.

2. RESULTS

As indicated in Table 1, 2494 titles with Library of Congress cataloging copy were examined and 1312 data fields were changed. The number of titles examined and the number of fields changed varied considerably from library to library.

The fact that the University of Vermont uses the Dewey Decimal Classification system rather than the Library of Congress system has a considerable affect on many of the statistics gathered. All of Vermont's 439 titles examined contained a change in call number. This represents about a third of the 1312 changes made in all fields by all libraries. Since call number changes of this type are replacements of data involving the entire field, the additions-replacements-deletions statistics and the partial versus entire field statistics were also affected.

59.60% of the 1312 changes were instances in which data was replaced; 29.42% of the changes were adding data; and 10.98% of the changes were deleting data. 73.25% of the 1312 changes were changes involving the entire field - i.e., all of the MARC subfields contained in it were changed - whereas 26.75% of the 1312 changed involved changing only part of the field - i.e., one or more of the subfields contained in it were not changed.

2.0 MARC II DATA FIELDS CHANGED

Table 2 presents total and individual library statistics on the number of changes made to each MARC II data field. Table 3 compares the frequency of changes in each field for all libraries with its frequency in each of the five libraries.

There were more changes in call numbers than in any other data fields. The changes in call number (602) represented 45.88% of the 1312 changes. As indicated in Table 3, the call number was the most changed field for Rhode Island and Vermont; it ranked second for New Hampshire and third for Connecticut and Maine.

Although no two libraries had the same frequency rating for the data fields changed, there is a certain amount of similarity among the libraries in that the data fields changed the most and the data fields changed least are pretty much the same for the five libraries.

In Table 4, the number of additions, replacements, and deletions are shown for each data field and the percent which each of the three categories represent of the total number of changes made in the field. From this table it can be seen that some of the changes do not represent an addition, replacement, or deletion of data in the MARC record, but rather a change in what is done with the data. In the Added Entries, Title field, the 30 additions are really changes in the tag given to the title statement, not a change in data. Such changes are to be expected among libraries with divided catalogs who will want to make added entries for titles not needed in a dictionary catalog. The 3 deletions of "Added Entries, Title" are instances of the libraries not wanting added entries for titles when the Library of Congress thought they were needed. In terms of the MARC format, the tags for these 3 title statements would require a change.

The additions and deletions to the "Added Entries (Series)" fields are other examples of changes in what is done with the data rather than changes in the data itself. Additions represent changes in the MARC tag for series statement from series entries not made to series entries made. Deletions represent changes in the tag for series statement from series entries made to series entries not made.

To accommodate these changes in what is done with the data, the capability to change tags as well as data would be desirable.

Table 5 indicates the number and percent of the changes for each data field that were partial field changes and entire field changes. Since some MARC II fields -- Notes, Added Entries, Titles, and Added Entries, Title -- contain only one subfield, all of the changes in these fields are entire field changes. The implications that the quantities of partial versus entire field changes have for the design of a program to modify MARC data are discussed in the following section on MARC II subfields changed.

2.1 MARC II SUBFIELDS CHANGED

Tables 6 through 19 give total and individual library statistics for each data field indicating the number of partial and entire field changes that are added, replaced, and deleted. The subfields changed in partial field changes are also indicated.

The most frequently changed subfield was the date (subfield "C") in the imprint statement with a total of 91 changes. The high total for imprint date changes was not the result of one library having an exceedingly large number of date changes but resulted from high number of changes in most of the libraries. The capability to accommodate change at the subfield level would reduce considerably the amount of data that has to be input to change imprint dates because the place and publisher would not have to be input.

The book number subfield "b", in the call number field had 80 changes. In conversations with the NELINET librarians, it was learned that many of the changes in the book number field involved the year that is added to the Cutter number rather than the Cutter number itself. Vermont, of course, did not have any changes of this type since they replaced the entire call number field in all records. Having the capability to change at the subfield level would not result in a significant savings in input effort because the class number subfield does not contain a large number of characters. The entire call number field, both class number and book number, is a relatively short data field.

The pagination subfield in the collation statement ranked third among changes for individual subfields with a total of 48 changes. 32 of these were made by Rhode Island. In the 689 titles that Rhode Island analyzed for this survey, there were a large number of Spanish titles. These titles produced a larger number of changes in the call number, collation, and edition fields than did the other titles examined and affected their statistics considerably.

There were 37 changes in the edition subfield of the edition statement field, 34 of which were made by Rhode Island. The large number of Spanish titles in their sample may have been the reason for this. It is also possible that changes recorded as partial changes involving the edition subfield were actually changes involving the entire edition statement field. The identification of edition data in the MARC format may be confusing unless one has had experience in MARC II tagging or a more thorough indoctrination in it than was presented in the instructions for performing this study.

Although in the MARC format the number of volumes is identified as the pagination subfield, in this study changes in number of volumes were kept separate from changes in pagination. This was done so that some idea of the number of this type of change could be obtained. Multivolume works not complete at the time of processing are a category of materials that any machine readable holdings record will have to consider. Also any discrepancies between the number of volumes cataloged by the Library of Congress and the number of volumes owned by a library will require a change of this type. There were 20 changes in the number of volumes.

Although the place subfield in the imprint statement field and the publisher subfield in this field did not represent a large number of changes when changes involving only the one field are considered, if combinations of these fields with each other and with the data subfield - e.g., place-publisher; place-date; publisher-date - are also considered, they each add up to 22 changes involving place and 21 changes involving publisher.

As can be seen in Tables 6 through 19, there was relatively little change in the other MARC subfields wherein the entire field was not changed.

3. CONCLUSIONS AND COMMENTS

A considerable number of changes were made in the titles examined for this study. The large number of changes in call number has proven the usefulness of the capability to change the call number which is already programmed in the NELINET system. The capability to change data at the subfield level would also be desirable, especially in changing imprint dates. The capability to change what is done with the date - i.e., changing the title statement and series statement tags - would also be useful.

Any system for maintaining machine readable holdings files should also consider that all monographic records are not complete at the time of processing. Multivolume works issued over a period of time are an example of such materials, and holdings files would require updating of the imprint date, number of volumes, and contents notes fields, if contents notes are present in the record.

Another consideration is that the capability to change MARC data will require that the person inputting the changes be familiar with the way that data is identified on the MARC record. This is not a simple matter.

It should also be noted that librarians are not used to thinking of anything other than the printed card product. They are not conscious of the machine file. They will quickly make changes on catalog cards and not realize that the machine file is unchanged. When products are made from this file, there will be errors in them as a result. It would be well if ways could be found to effectively orient the librarians so that they become conscious of the machine file before large amounts of data are accumulated containing many errors.

This study was performed before the NELINET libraries began to purchase card products from the NELINET production system. Impressions derived from conversations with the librarians on the use of these cards suggest that the NELINET cards are not changed as often as indicated in this study. This may be because the materials requested from the NELINET system are new works and Library of Congress cataloging matches the books more often. It may also be somewhat affected by the fact that there are no spaces between lines on NELINET cards. Additions therefore cannot be made as easily as they can on Library of Congress cards.

Finally, the whole subject of changing Library of Congress data could benefit from some additional thought being given to it at both the Library of Congress and the libraries that use their cataloging copy. Some changes -

those in the imprint and in the collation - were made because the book cataloged at the Library of Congress did not match the book cataloged in the NELINET library. Current cataloging rules and current cataloging practice among most university libraries is to have the cataloging match the book. Such changes, therefore, are to be expected. Changes such as making title added entries when the library has a divided catalog are also understandable and to be expected.

Other changes are more difficult to understand. The Library of Congress is supposed to be giving "full" cataloging treatment to the books it is processing. This cataloging would be expected to be "full" enough for libraries such as the NELINET State University libraries. More than one NELINET library expressed dissatisfaction with the Library of Congress's treatment of series. Another library mentioned that they added notes (or changed the imprint) to record the fact that the work cataloged was the reprint of an earlier work. This is desirable bibliographic information for anyone researching a subject.

It would seem that calling the Library of Congress's attention to such matters as the treatment of particular series might be more desirable than just continuing to change Library of Congress cards. That is, of course, if there is some agreement among the libraries who disagree with the Library of Congress as to what the proper treatment should be. It may also be that further study of the changes that a particular library makes in adding to or changing the Library of Congress's bibliographic data may not be worth it.

TABLE 1

CHANGES IN L.C. CATALOGING COPY - SUMMARY

	Connecticut		Maine		New Hampshire		Rhode Island		Vermont		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Titles Examined (L.C. Copy)	654		183		529		689		439		2494	
Data Fields Changed	186		49		188		300		589		1312	
Changes/Titles Percentage	28.44		26.78		35.54		43.54		134.17		52.61	
Additions	127	68.28	37	75.51	64	34.04	110	36.67	48	8.15	386	29.42
Replacements	27	14.52	5	10.20	76	40.43	162	54.00	512	86.93	782	59.60
Deletions	32	17.20	7	14.29	48	25.53	28	9.33	29	4.92	144	10.98
Entire Field Changes	152	81.72	28	57.14	125	66.49	124	41.33	532	90.32	961	73.25
Partial Field Changes	34	18.28	21	42.86	63	33.51	176	58.67	57	9.68	351	26.75

TABLE 2

MARC II DATA FIELDS CHANGED

	Connecticut		Maine		New Hampshire		Rhode Island		Vermont		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Call Number	23	12.37	9	18.37	39	20.74	92	30.67	439	74.53	602	45.88
Main Entry	0		0		1	.53	0		1	.17	2	.15
Title Statement	1	.54	0		2	1.06	2	.67	2	.34	7	.53
Edition	1	.54	0		8	4.26	37	12.33	5	.85	51	3.89
Imprint	18	9.68	12	24.49	43	22.87	66	22.00	50	8.49	189	14.41
Collation	8	4.30	1	2.04	14	7.45	68	22.67	21	3.57	112	8.54
Series Statement	7	3.76	0		10	5.32	9	3.00	6	1.02	32	2.44
Notes	27	14.52	11	22.45	21	11.16	14	4.67	27	4.58	100	7.62
Subject Entries	13	6.99	0		0		3	1.00	0		16	1.22
AE Names	5	2.69	4	8.16	0		2	.67	1	.17	12	.91
AE Title	21	11.29	3	6.12	2	1.06	7	2.33	3	.51	36	2.74
AE Title:mm	1	.54	0		7	3.72	0		0		8	.61
AE (Series)	59	31.72	0		29	15.43	*		18	3.06	106	8.08
AE (Series:mm)	2	1.08	9	18.37	12	6.38	*		16	2.72	39	2.97
Total Changes	186	100.00	49	100.00	188	100.00	300	100.00	589	100.00	1312	100.00

*Not available -- not indicated on shelf list cards.

TABLE 3

FREQUENCY RATING OF DATA FIELD CHANGES

Rating All Libraries	Data Field	Rating Connecticut (1-12)	Rating Maine (1-7)	Rating New Hampshire (1-12)	Rating Rhode Island (1-10)	Rating Vermont (1-12
1.	Call Number	3	3	2	1	1
2.	Imprint	5	1	1	3	2
3.	Collation	7	6	5	2	4
4.	AE (Series)	1	7	3	*	5
5.	Notes	2	2	4	5	3
6.	Edition	11	7	8	4	8
7.	AE (Series:mn)	10	3	6	*	6
8.	AE Title	4	5	10	7	9
9.	Series Statement	8	7	7	6	7
10.	Subject Entries	6	7	12	8	12
11.	AE Names	9	4	12	9	11
12.	AE Title:mn	11	7	9	10	12
13.	Title Statement	11	7	10	9	10
14.	Main Entry	12	7	11	10	11

*Not available -- not indicated on shelf list cards.

TABLE 4

MARC II DATA FIELDS CHANGED - ADDITIONS, REPLACEMENTS, AND DELETIONS

	Additions		Replacements		Deletions		Total	
	No.	%	No.	%	No.	%	No.	%
Call Number	82	13.62	515	85.55	5	.63	602	100
Main Entry	2	100.00	0	0.0	0	0.0	2	100
Title Statement	2	28.57	3	42.85	2	28.57	7	100
Edition	27	52.94	15	29.41	9	17.65	51	100
Imprint	46	24.34	140	74.07	3	1.59	189	100
Collation	22	19.64	77	68.75	13	11.61	112	100
Series Statement	20	62.50	7	21.88	5	15.63	32	100
Notes	72	72.00	7	7.00	21	21.00	100	100
Subject Entries	10	62.50	3	18.75	3	18.75	16	100
Added Entries, Names	8	66.67	2	16.67	2	16.67	12	100
Added Entries, Title	30	83.33	3	8.33	3	8.33	36	100
Added Entries, Title:	8	100.00	0	0.0	0	0.0	8	100
Added Entries (Series)	48	45.28	3	2.83	55	51.89	106	100
Added Entries (Series:)	9	23.08	7	17.95	23	58.97	39	100

TABLE 5

MARC II DATA FIELDS CHANGED - PARTIAL VS ENTIRE FIELD CHANGES

	Partial		Entire		Total	
	No.	%	No.	%	No.	%
Call Number	81	86.54	521	13.46	602	100
Main Entry	2	100.00	0	0.0	2	100
Title Statement	6	85.71	1	14.29	7	100
Edition	38	74.51	13	25.49	51	100
Imprint	123	65.08	66	34.92	189	100
Collation	88	78.57	24	21.43	112	100
Series Statement	5	15.63	27	84.38	32	100
Notes	-	-	100	100.00	100	100
Subject Entries	2	12.50	14	87.50	16	100
Added Entries, Names	5	41.67	7	58.33	12	100
Added Entries, Title	-	-	36	100.00	36	100
Added Entries, Title:m	-	-	8	100.00	8	100
Added Entries (Series)	0	0.0	106	100.00	106	100
Added Entries (Series:m)	1	2.56	38	97.44	39	100

TABLE 6

CHANGES IN THE CALL NUMBER FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	12b's	4	16	0	3	3	4b's	0	4	16b's	7	23
Maine	5b's	0	5	1a	2	3	1b	0	1	1a 6b's	2	9
N. H.	17b's	2	19	0	20	20	0	0	0	17b's	22	39
R. I.	26b's	16	42	15b's	35	50	0	0	0	41b's	51	92
Vt.	-	-	-	0	439	439	0	0	0	0	439	439
Total	60b's	22	82	1a 15b's	499	515	5b's	0	5	1a 80b's	521	602

Call Number Subfields

a -- Classification Number
b -- Book Number

TABLE 7

CHANGES IN THE MAIN ENTRY FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	0	0	0	0	0	0	0	0	0	0	0
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	1d	0	1	0	0	0	0	0	0	1d	0	1
R. I.	0	0	0	0	0	0	0	0	0	0	0	0
Vt.	1d	0	1	0	0	0	0	0	0	1d	0	1
Total	2d	0	2	0	0	0	0	0	0	2d	0	2

Main Entry Subfields

Personal

a -- Name
b -- Numeration
c -- Titles
d -- Dates
e -- Relator
k -- Form Subheading
t -- Title (of Book)

Corporate

a -- Name
b -- Each Subordinate Unit
k -- Form Subheading
t -- Title (of Book)

Conference

a -- Name
b -- Number
c -- Place
d -- Date
e -- Subordinate Unit
k -- Form Subheading
t -- Title (of Book)

TABLE 8

CHANGES IN THE TITLE STATEMENT FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	1b	0	1	0	0	0	0	0	0	1b	0	1
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	0	0	0	1c	0	1	0	1	1	1c	1	2
R. I.	0	0	0	1c	0	1	1b	0	1	1b 1c	0	2
Vt.	1b	0	1	1b	0	1	0	0	0	2b	0	2
Total	2b	0	2	1b 2c	0	3	1b	1	2	4b 2c	1	7

Title Statement Subfields

a -- Short title from which added entry is generated.
b -- Remainder of title.
c -- Remainder of title page transcription.

TABLE 9

CHANGES IN THE EDITION FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	1	1	0	0	0	0	0	0	0	1	1
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	0	1	1	0	1	1	0	6	6	0	8	8
R. I.	22a	1	23	10a	2	12	2a	0	2	34a	3	37
Vt.	1a 1b	0	2	2a	0	2	0	1	1	3a 1b	1	5
Total	23a 1b		27	12a	3	15	2a	7	9	37a 1b	13	51

Edition Subfields

a -- Edition.
b -- Additional information after edition.

TABLE 10

CHANGES IN THE IMPRINT FIELD AND SUBFIELD

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	1c	5	6	1a,3ab, 2b,3c	3	12				1a,3ab, 2b,4c	8	18
Maine	8c	3	11	1ab	0	1				1ab,8c	3	12
N. H.	1a, 2c	1	4	1a,1bc, 27c	10	39				2a, 1bc, 29c	11	43
R. I.	2a, 2ab 2bc, 5c	6	17	1a,3ab, 1b,1bc, 14c,5ac	21	46	3c	0	3	3a,5ab, 1b,3bc, 22c,5ac	27	66
Vt.	1ab, 4c	3	8	1ab,3bc 24c	14	42				2ab,3bc, 28c	17	50
Total	3a, 3ab 2bc,20c	18	46	3a,8ab, 5ac,3b, 5bc,68c	48	140	3c	0	3	6a,11ab, 3b,7bc, 91c,5ac	66	189

Imprint Subfields

a -- place
b -- publisher
c -- date

TABLE 11

CHANGES IN THE COLLATION FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	2	2	1ac,3av	0	4	1c	1	2	3av,1ac 1c	3	8
Maine	1a	0	1	0	0	0	0	0	0	1a	0	1
N. H.	4av	0	4	5a,1bc, 1c	3	10	0	0	0	5a,1bc 4av,1c	3	14
R. I.	9av	3	12	32a,3c	10	45	2av,9b	0	11	32a,9b 11av,3c	13	68
Vt.	1a,2av	0	3	9a,3c, 1ac	5	18	0	0	0	10a,3c 1ac,2av	5	21
Total	2a,15av	5	22	46a,1bc, 2ac,7c 3av	18	77	2av,9b 1c	1	13	48a,9b 2ac,1bc 20av,8c	24	112

Collation Subfields

a -- Pagination
b -- Illustration Statement
c -- Size

TABLE 12

CHANGES IN THE SERIES STATEMENT FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	5	5	0	0	0	1a (title)	1	2	1a (title)	6	7
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	0	7	7	0	2	2	0	1	1	0	10	10
R. I.	1t	3	4	2v	2	4	0	1	1	1t,2v	6	9
Vt.	1v	3	4	0	1	1	0	1	1	1v	5	6
Total	1t,1v	18	20	2v	5	7	1a (title)	4	5	1a (title) 1t,3v	27	32

Series Statement Subfields, Author-Title

a-t -- Same as main entry names
v -- Volume

Series Statement Subfields, Title

a -- Title
v -- Volume

TABLE 13

CHANGES IN THE NOTE FIELD

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	-	19	19	-	2	2	-	6	6	-	27	27
Maine	-	10	10	-	0	0	-	1	1	-	11	11
N. H.	-	19	19	-	2	2	-	0	0	-	21	21
R. I.	-	8	8	-	0	0	-	6	6	-	14	14
Vt.	-	16	16	-	3	3	-	8	8	-	27	27
Total	-	72	72	-	7	7	-	21	21	-	100	100

TABLE 14

CHANGES IN THE SUBJECT ENTRY FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	-	8	8	-	2	2	-	3	3	-	13	13
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	0	0	0	0	0	0	0	0	0	0	0	0
R. I.	2a	0	2	0	1	1	0	0	0	2a	1	3
Vt.	0	0	0	0	0	0	0	0	0	0	0	0
Total	2a	8	10	0	3	3	0	3	3	2a	14	16

Subject Entry Subfields

a -- Main Heading
x -- General Subdivision
y -- Period Subdivision

TABLE 15

CHANGES IN NAME ADDED ENTRY FIELD AND SUBFIELDS

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	3	3	1a	0	1	0	1	1	1a	4	5
Maine	1a,1ad 1d	0	3	1a	0	1	0	0	0	2a,1ad 1d	0	4
N. H.	0	0	0	0	0	0	0	0	0	0	0	0
R. I.	0	1	1	0	0	0	0	1	1	0	2	2
Vt.	0	1	1	0	0	0	0	0	0	0	1	1
Total	1a,1ad 1d	5	8	2a	0	2	0	2	2	3a,1ad 1d	7	12

Name Added Entry Subfields

same as main entry names

TABLE 16

CHANGES IN THE TITLE ADDED ENTRY FIELD

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	-	21	21	-	0	0	-	0	0	-	21	21
Maine	-	3	3	-	0	0	-	0	0	-	3	3
N. H.	-	2	2	-	0	0	-	0	0	-	2	2
R. I.	-	1	1	-	3	3	-	3	3	-	7	7
Vt.	-	3	3	-	0	0	-	0	0	-	3	3
Total	-	30	30	-	3	3	-	3	3	-	36	36

TABLE 17

CHANGES IN THE ADDITIONAL TITLE ADDED ENTRY FIELD

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	-	1	1	-	0	0	-	0	0	-	1	1
Maine	-	0	0	-	0	0	-	0	0	-	0	0
N. H.	-	7	7	-	0	0	-	0	0	-	7	7
R. I.	-	0	0	-	0	0	-	0	0	-	0	0
Vt.	-	0	0	-	0	0	-	0	0	-	0	0
Total	-	8	8	-	0	0	-	0	0	-	8	8

TABLE 18

CHANGES IN SERIES ADDED ENTRY FIELD AND SUBFIELDS

(Traced as in Series Statement)

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	43	43	0	3	3	0	13	13	0	59	59
Maine	0	0	0	0	0	0	0	0	0	0	0	0
N. H.	0	0	0	0	0	0	0	29	29	0	29	29
R. I.	*	*	*	*	*	*	*	*	*	*	*	*
Vt.	0	5	5	0	0	0	0	13	13	0	18	18
Total	0	48	48	0	3	3	0	55	55	0	108	106

* Not available - not indicated on shelf list cards.

Series Added Entry Subfields

same as series statement

TABLE 19

CHANGES IN SERIES ADDED ENTRY FIELD AND SUBFIELDS

(Not Traced as in Series Statement)

	Added			Replaced			Deleted			Total		
	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total	Partial Field	Entire Field	Total
Conn.	0	1	1	0	0	0	0	1	1	0	2	2
Maine	0	4	4	0	0	0	0	5	5	0	9	9
N. H.	0	0	0	1t	0	1	0	11	11	1t	11	12
R. I.	*	*	*	*	*	*	*	*	*	*	*	*
Vt.	0	4	4	0	6	6	0	6	6	0	16	16
Total	0	9	9	1t	6	7	0	23	23	1t	38	39

*Not available -- not indicated on shelf list cards.

Series Added Entry Subfields

same as series statements

APPENDIX III

FILE ORGANIZATION

by

William R. Nugent

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1. INTRODUCTION

The development of a machine form union catalog for NELINET will extend the function of the network to provide for the collection and use of library holdings information, in addition to the collection and use of LC MARC II data that was the subject of previous network development.

The machine form union catalog is being designed for regional use on a time-shared basis, using a large random-access memory and a central computer that will have communications links to the participating libraries. The system is being developed on a service-bureau machine, a Digital Equipment Corporation PDP-10, which is the same type planned for the NELINET center.

The end result of this project will be the development of a Holdings File Processing Program, which will permit the collection, storage, and updating of a union holdings file.

The present report describes the design of the file organization that will be used for the overall system. Because we did not wish to design the organization of the holdings file out of the total system context, we have included in our plans certain items that will not be developed into programs under this project, such as author-title searching of the MARC II file.

The organization of the files presented here, will serve as the basis for the ultimate disc-oriented system, rather than the interim system based on magnetic tape that is temporarily more economical.

1.1 APPROACH

The File Organization study of this report has been conducted to insure that the Holdings File Processing Programs we are developing, will be compatible with the 5-year projection of the total system. To this end, we have conducted an extensive literature survey of approaches to file organization, and have examined the main files of the system, their growth, and possible influence on each other and on service capacity.

1.2 SUMMARY OF RESULTS

The final section of this report describes the proposed file organization of the system. The principal

design factors that influence the Holdings File Processing Program (HFPP) are as follows:

1. **Regional holdings records are in a separate file, and not physically appended or link-addressed to the MARC II file.**

2. **Primary (one-level) access to both the Regional Holdings File and the MARC II file is by L.C. Card Number.**

3. **An L.C. Card Number directory, in the on-line system, will contain for each L.C. Card Number in the system, the address of the group of regional holdings records of that L.C. Card Number, if any.**

4. **As a consequence of (3), the Holdings File will be in random order, as is the MARC II file, though holdings of the same L.C. Card Number will be adjacent.**

5. **As a consequence of (4), Holdings File updating operations will involve pop-up, push down processing.**

6. **While holdings collections are small, simple sequential search access to the clustered holdings records of an L.C. Card Number will be sufficient. As the holdings records of one L.C. Card Number grow beyond one-track capacity ($\approx$80 holdings records), address headers at each cluster may be useful.**

7. **Secondary access, via second level directories to L.C. Card Numbers, is by Author-Title and Holding Institution.**

8. **The Regional holdings records are in mapped NELINET internal format of the same general structure as the MARC II records.**

9. **Directories may be distributed for efficiency among memory modules with independent access means (i.e., the 2 modules of the Bryant Disc, or the 8 modules of the IBM 2314). Hence, "module directories" will precede the precise location directories, which will require address-calculation methods, and assignment by address range of records to storage modules.**

10. **The on-line system will use optimization techniques appropriate to the particular disc geometry being utilized (or related access characteristics of other mass storage devices) and will not use a 'virtual memory' approach under control of an operating system.**

11. **System indexes used for coordinate indexing (e.g., occurrence lists of author title words, etc.) will be inverted lists rather than threaded lists.**

2. OBJECTIVES AND APPLICATIONS

The machine form union catalog is essentially a composite file of MARC II and local data. Like all data bases considered for inclusion in the system, it is oriented to search application; both on demand and batch processed. The principal applications of the machine form union catalog will be in services as per the present NELINET system in book catalog production, both regional and local, in the production of derivative data files for uses at other processing centers, and in data retrieval in support of other library functions, such as acquisitions.

Basically, we are designing a file organization to permit on-line time-shared access to a very large data base on random access mass storage. The fact that certain applications programs may be more efficiently run in batch mode does not concern us in this report, since we are primarily concerned here with file organization for record retrieval independent of subsequent processing for output.

3. DATA BASE - SIZE AND GROWTH

We are concerned with file organization for two principal data bases: the L.C. MARC II file of cataloging records; and, the Holdings file of the holdings and local data of participating libraries. The L.C. MARC II file may have several sources of data: the on-going current imprint English language cataloging records, future coverage of current imprint foreign materials, and the planned L.C. RECON Project which will extend MARC coverage to retrospective materials, both English and Foreign. The Holdings file will contain holdings information derived from the libraries' machine-form requests for processing, plus added local data.

The size and projected growth pattern of these data bases are considered following, and are illustrated in Figure 1, based on data in the L.C. RECON report[2].

3.1 MARC II (CURRENT IMPRINT)

As of July, 1970, we have collected approximately 72,000 current imprint English language records from the MARC II distribution. The annual growth of this file is in the order of 70,000 to 80,000 records per year. As of 1975, we estimate there will be 425,000 records of current imprint English language records.

The production of current imprint foreign language material is scheduled to begin in 1970, and the total number of current imprint records in all languages by January, 1975 is expected to be 1,183,000.

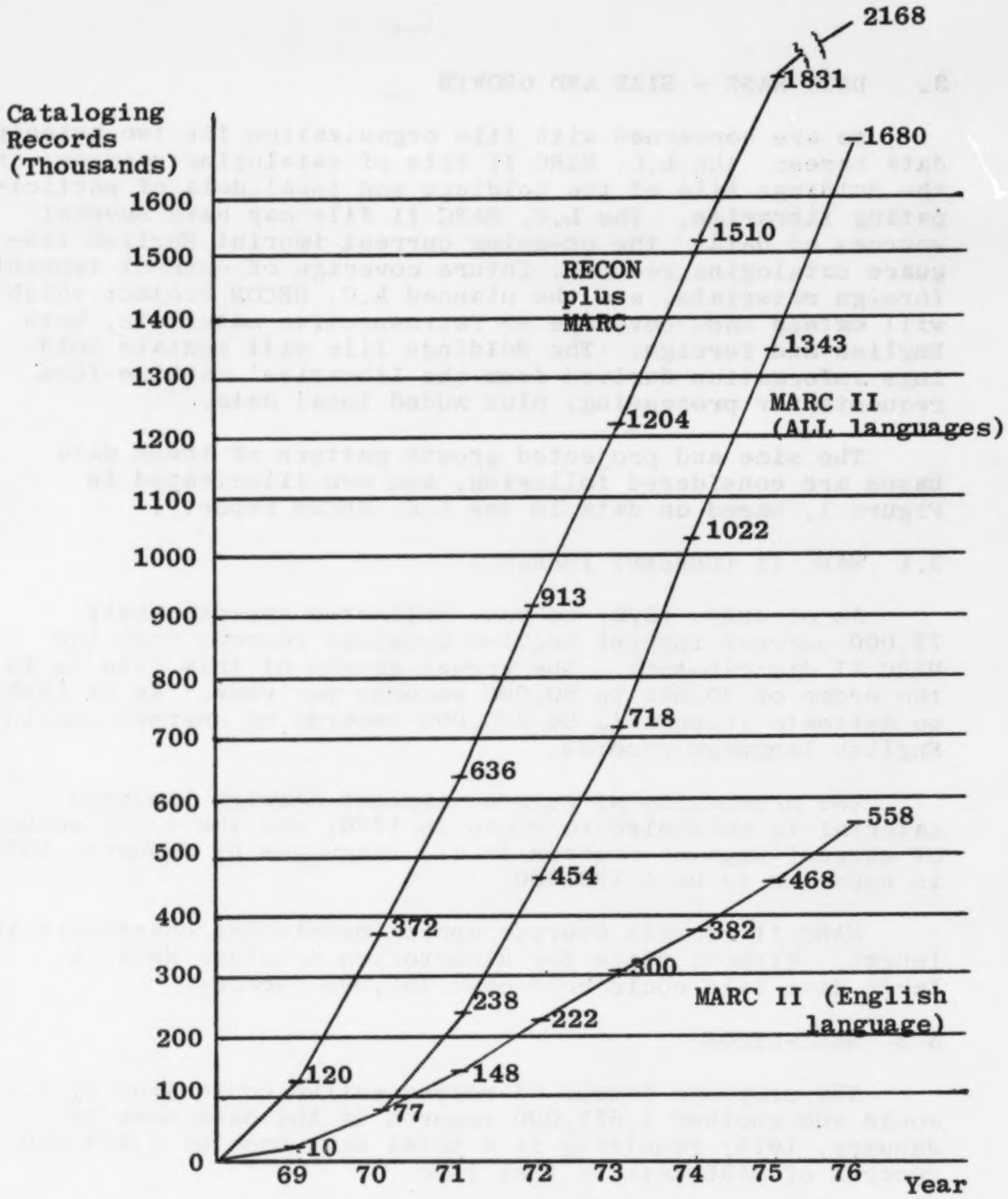
MARC II records average approximately 584 characters in length. Without space for directories or other data, a large disc file could hold over 850,000 records.

3.2 MARC-RECON

The proposed levels of retrospective conversion by L.C. would add another 1,671,000 records to the data base by January, 1975; resulting in a total data base of 2,854,000 records of MARC data by that time.

3.3 REGIONAL HOLDINGS FILE

The holdings records are expected to contain an average of 90 characters of data, largely reflecting the data received at request time concerning the location, volume, and copy information for each item. Since in a future system local data elements could be substituted for any MARC II data element, the maximum size of a holdings record could exceed the size of a MARC record. The 90 character estimate



Projected Size of Data Base

(numbers on curves are mid-year estimates in thousands)

Figure 1

used here assumes only the usual request data.

In the New England Area to be serviced by NELINET, there are in excess of 300 college and university libraries, with total collections of several million volumes.

3.4 SIZES ASSUMED FOR FILE ORGANIZATION STUDY

For this study, we have assumed an initial on-line system capacity objective of one million records, consisting of 500,000 MARC records and 500,000 holdings records. While this is less than the total possible in the five-year projection of growth, it is sufficiently large to condition the file organization study, and would appear a reasonable capacity for one large disc system of current production. In our earlier reports, we have estimated a single system service capacity to be in the order of 50 to 100 large libraries. This still appears reasonable.

4. RANDOM ACCESS MASS STORAGE DEVICES

The data bases will be stored on large random-access mass storage devices. We currently consider large disc files, such as those produced by IBM, Bryant, Memorex, etc. as these represent the best choice of devices now in common commercial use. In a later section, we consider larger mass storage devices, expected to be available in the near future.

The accompanying table shows the direct costs of two representative storage devices. The figures for the IBM 2314 are derived from Abate, et al[1]; the figures for the Bryant are from an earlier NELINET study[32]. The access rates are approximate maximums. The access figures assume an equal probability of requests distributed among the cylinders of each disc, and a first come - first served service policy. We are currently considering other service policies of greater sophistication, and means for minimizing factors leading to non-uniform distribution of requests.

The discs described may, of course, be used in multiples to obtain greater storage, or mixed to obtain special characteristics. The Library of Congress Retrospective Conversion (RECON) report[2], for instance, describes a configuration of one 2314 disc to serve as directory storage for each group of seven Bryant disc catalog files.

In this case, the faster access of the 2314 disc makes it especially suitable for heavily accessed directories, and the less expensive cost of storage of the 4000-2A disc makes it more suitable for massive bulk storage.

For the million record file we are considering, we will assume one Bryant 4000-2A, two IBM 2314's, or similar units of like capacity.

	Bryant 4000-2A	IBM 2314
Drives	1 (Dual Access)	8
Cylinders	3072	1600
Tracks	36,864	32,000
Characters	500,000,000	233,000,000
Max. MARC Records	856,000	399,000
Approx. Mo. Rental	$8,350	$5,570
Approx. Max. Access Rate	10/sec.	35/sec.
Approx. Min. Access Time	200/ms.	226/ms.
Min. Cost Per MARC II Rec.[1]	0.97¢/mo.	1.4¢/mo.
Min. Cost Per Access[2]	0.132¢	0.025¢

Characteristics of Typical Discs

1) based on cost applied to storage only, at maximum density, without directories

2) based on cost applied to access only, not including computer time, full utilization, 1 shift

Figure 2

5. STORAGE ALLOCATION: OPERATING SYSTEM vs. USER SYSTEM

In the service bureau operations of the current project, the allocation of storage to disc has been under the control of the service bureau operating system, under which blocks of 768 characters (128 computer words) are passed back and forth between the disc and the local program component requesting or delivering data. The operating system, in this case the PDP-10/50 Monitor, assigns disc storage locations according to availability and maintains the required directories to access user files. This has provided the advantage of device-independence and is a convenient means of operating in a service bureau environment when processing programs rather than retrieval programs are being run. For retrieval applications, there is the problem of not being able to optimize storage so as to minimize access time. In a dedicated center this would certainly be done. However, such optimization may become possible in the future with service bureaus since they are now hinting at new services wherein one or more entire disc drives would be made available to clients, with means for by-passing the monitor and addressing disc locations directly.

As soon as dedicated storage became available (at a service bureau or NELINET center) we would wish to address it directly for building and using files and directories, though storage for processing programs might continue to be serviced through the monitor.

Hence, in our study of file organization, we have assumed the facility to perform physical organization as well as logical organization.

6. TIME ALLOCATION: SEARCH RATE vs. SERVICE RATE

In Figure 2, the table of disc characteristics, we list approximate figures for access rates and access times for two typical discs. These figures are for search rates in the sense of access to disc records. From a standpoint of file organization, we are more interested in service rates, or the number of total retrieval queries per unit time. In this section we explain why search rates are not service rates, and discuss several of the factors involved in deriving service rates from search rates.

6.1 SEARCH RATE ESTIMATES

There are perhaps three basic ways to estimate search rates, such as the rates in Figure 2. One is to itemize the component disc functions in a search, determine average times for each separate function, and sum these averages. This leads to a reasonable figure, but one that tends to be better than that obtained in production use. The figures for the Bryant disc were obtained this way, and considered arm positioning time, track verification time, rotation delay to track start, rotation delay to record start, and record transmission time. A second method was used by Abate, et al[1], to determine search rates for the IBM 2314. This method involved a queuing analysis of the disc considered as a stochastic service system, in which the distributions of random variables were considered as well as their averages, and response time distributions were obtained. The method is suited to any system for which a piecewise linear approximation can be obtained for arm positioning time as a function of tracks travelled, and makes use of a novel technique for the numerical inversion of Laplace transforms. Abate's method would be useful in comparing specific hardware considered for a dedicated center. A third method of estimating is via computer simulation, which is most often a method too expensive to consider.

6.2 EFFECT OF MULTIPLE DISCS AND MULTIPLE DATA CHANNELS

Multiple discs are not multiple "servers" in the formal queuing theory sense, but may have many of the virtues of replicated files under the right conditions. If there is a uniform distribution of demand among the eight disc drives of an eight drive system, this can approximate the service possible with several identical complete files on individual drives. Since arm-positioning time is the largest factor in disc access, the more independently positionable arms, the better the access rates. In our early analysis of the dual-access Bryant, for example, we planned to maximize simultaneous dual utilization by making the system directories available on both banks of the disc.

One ultimate limit on the number of separate drives in a system is the channel capacity to transmit data between disc and computer. The 2314, for example, has only one data channel for the eight drives; the Bryant may have two for its two banks depending on the computer. An analysis of the channel queue would have to be added to Abate's model for any high utilization system involving shared channels.

6.3 WAITING TIME

Waiting time, prior to initiation of service, is another factor necessary in the model of service rate, and this increases with the number of users in the waiting queue, as demand rates approach the limit of service rates. Waiting time is also a function of the specific service policy, which is discussed in the following paragraph.

Using the model developed previously for a dedicated NELINET disc in a "two-server" system with "first come first served" service policy, 205,000 search requests per day could be serviced with an expected waiting time of 0.64 sec., and an expected queue length of 19. In this model, service requests required three search accesses, and the system could accomodate over 1000 service requests per day from each of 68 libraries.

6.4 SERVICE POLICY

"First Come First Served" (FCFS) is the simplest service policy, and one generally used by service bureau operating systems. For a dedicated center, there would be more efficient possibilities. Since disc arm positioning time (seek time) is the greatest source of delay in a disc system, one suggested policy has been "Shortest Seek Time First" (SSTF) in which the addressee sought by users in the queue would be examined and the position requiring the shortest travel would be selected first. Denning[9] has found this policy to be lacking, in that it discriminates towards users seeking positions near the center of the disc and users seeking positions near the disc's inner or outer edge would have long waiting times and no guarantee of service. Also, the one-step minimization does not result in a N-step minimization unless the starting position is on one side of the N positions. Denning also discusses a policy of continuous scanning of the track positions and servicing requests as they match the current position. This policy offers no priority to older requests, and also discriminates against users requiring access at disc edges.

Frank[16] suggests a policy that, while sub-optimal, appears to yield reasonable results. This is also a 'group' policy of the form "First N Come, First N Served", in that N

queue members' desired positions are examined and if the current head position is to one side of the group, the SSTF policy is used, otherwise the SSTF policy is applied twice, first to positions on one side of the present position, then to positions on the other side. Frank estimates that group service policies can reduce average access time to half that of FCFS service. Frank includes data on the IBM 2314 and the Bryant 4000, including a table of empirical seek times for the Bryant.

7. REQUEST PROCESSING AND FILE ORGANIZATION

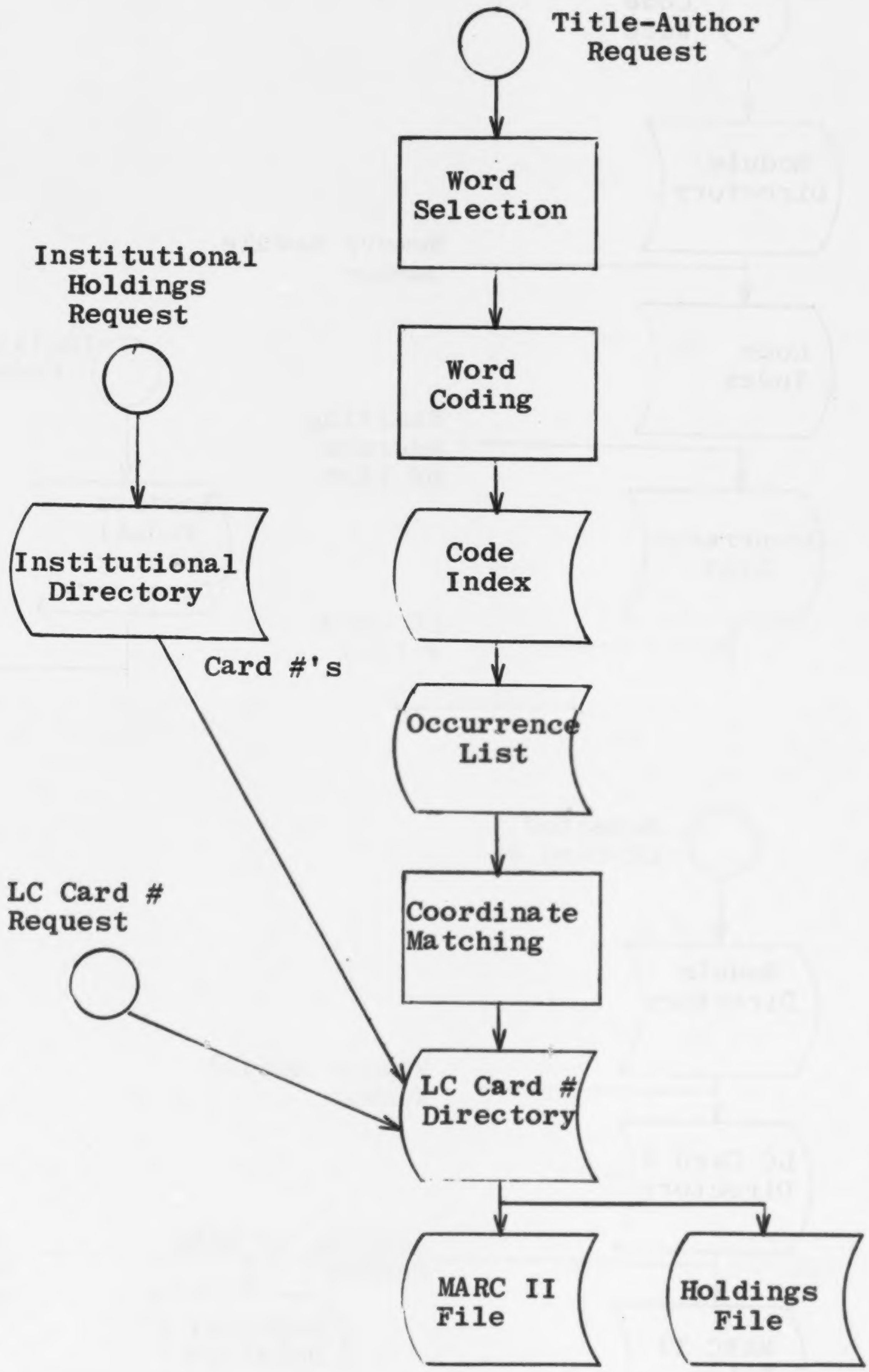
The NELINET system under consideration consists of two data bases and four directory files. These are shown in Figure 3 which shows the sequence of request processing, and Figure 4 which shows the file linkages and file output items. The two data bases are the MARC II file and the Holdings file. Both are in the standard mapped form of the NELINET internal format.

7.1 REQUEST PROCESSING

We access data base information via three principal methods in the projected on-line system. These are LC Card Number, Author-Title, and Holding Institution. We have, as shown in Figure 3, an LC Card Number Directory which points to both data bases as the primary means of access. To obtain regional holdings data, the entire holdings file may be output, or the LC Card Number Directory may be used as a source of our LC Card Number listing for those LC Card Numbers associated with the address of one or more holdings records. Institutional holdings directories are merely lists of LC Card Numbers, which in turn provide access through the LC Card Number Directory. For title-author requests, we use the methods described in an earlier NELINET report[33], wherein a set of representative words and other data is selected from title and author requests; these elements are compression-coded to fixed length; each is then looked up in a Code Index, which gives the starting address of an Occurrence List; the Occurrence List is accessed which contains corresponding LC Card Numbers for all occurrences of a selected code word in a selected word position; and then the several resulting lists of LC Card Numbers are subject to matching procedures to determine the one correct LC Card Number corresponding to the request, or the several possible LC Card Numbers. The LC Card Number or Numbers are then entry points to the LC Card Number Directory, via which the MARC records, the holdings records, or both, are accessed.

While the detailed methods of author-title searching require more analysis and design, and are not a subject of this contract, the files concerned, their organization and relationships, are of interest in obtaining a system overview, storage capacity estimate, and possible relationships to holdings file activity.

The six principal files are discussed below:


Title-Author Request
Word Selection
Institutional Holdings Request
Word Coding
Institutional Directory
Code Index
Card #'s
Occurrence List
LC Card # Request
Coordinate Matching
LC Card # Directory
MARC II File
Holdings File

REQUEST PROCESSING

Figure 3

FILE LINKAGES

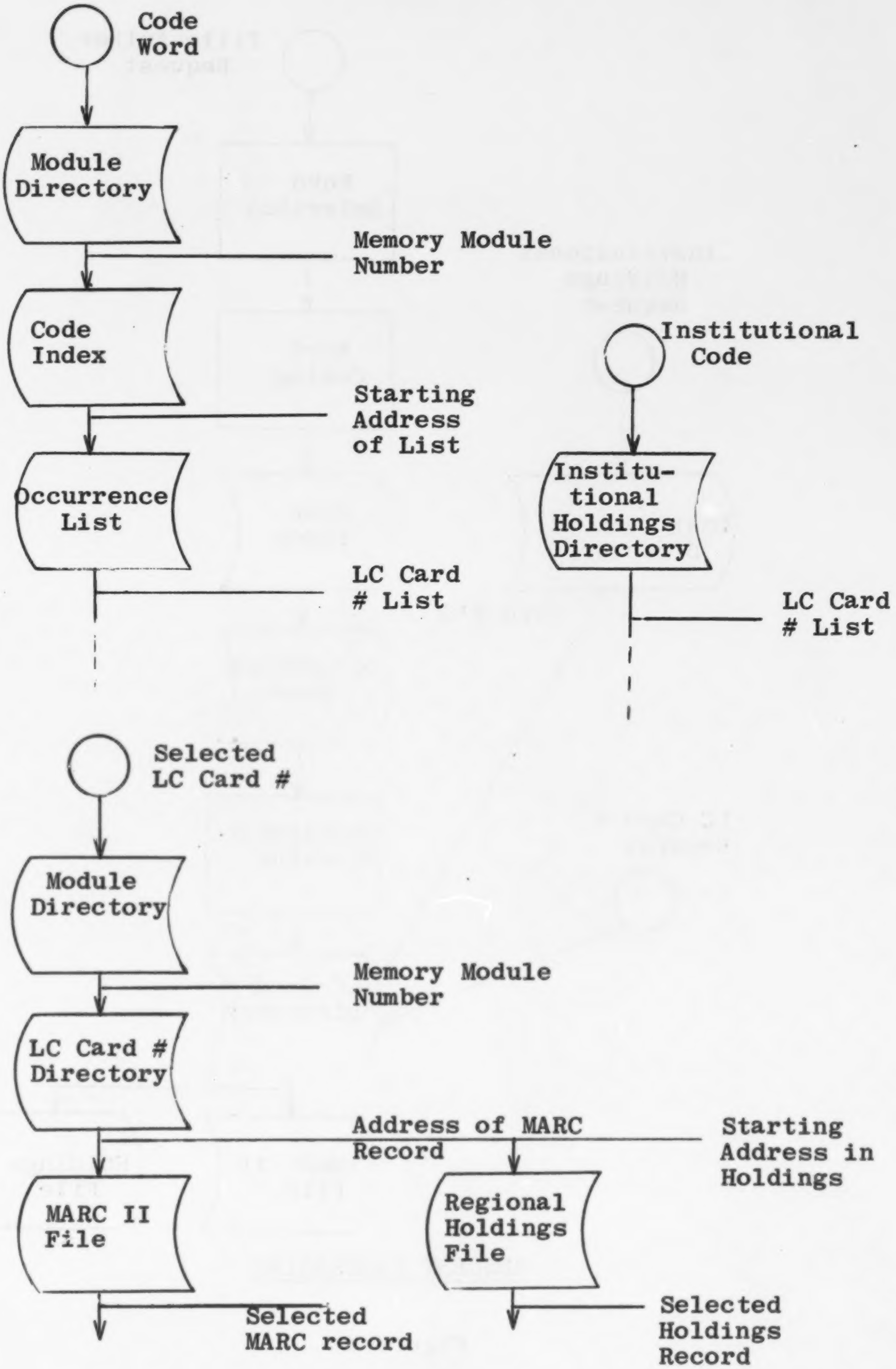

Code Word
Module Directory
Memory Module Number
Code Index
Starting Address of List
Occurrence List
LC Card # List
Institutional Code
Institutional Holdings Directory
LC Card # List
Selected LC Card #
Module Directory
Memory Module Number
LC Card # Directory
Address of MARC Record
Starting Address in Holdings
MARC II File
Regional Holdings File
Selected MARC record
Selected Holdings Record

Figure 4

7.2 MARC II FILE

The MARC II file contains records in accession order, which is broadly by LC Card Number currently, but not entirely since LC Card Numbers are often pre-assigned and do not get used in sequence, and hence do not have LC cataloging records created in sequence. The order will become more scrambled if retrospective cataloging records are entered as well, so that for all practical purposes, we assume a random ordered file. Because of the size of this file, it does not get updated - only its directories do. In cases where new MARC records cause cancellation of old records, the old records will be marked as 'abandoned', the new record will be added on the end, and the LC Card Number directory will have the file address updated. Periodically, the file will be rewritten in sequence and the dead space closed up.

During requests for technical processing, the extracted MARC II record would be operated on to produce for the processing program (CLPP) an institutionally-oriented MARC record containing additions, deletions, and substitutions indicated by the request or both the request and the holdings file in cases where the request indicates that processing is to be based on an existing holdings record. From the view of each holding institution, the NELINET MARC II file is made to appear as a virtual file of locally modified records.

We assume a size of 500,000 MARC records in the five year projection, and a consequent minimum storage requirement of 292 million bytes (characters).

7.3 REGIONAL HOLDINGS FILE

These records contain request data and local additions and changes to MARC data, and are estimated to average about 90 characters each. They too, are in entry order, by first entry of a particular card number, and successive holdings of that same LC Card Number are packed in the same cluster. The directory points to the address of the first record of a particular LC Card Number, and successive records are accessed by sequential search. Because of the mapped structure of the holdings record, it is easy to perform successive address calculation to obtain successive starting addresses. In a sense, this resembles a threaded list approach within each cluster except that the records accessed are positioned sequentially. For a file of 500,000 holdings records, we estimate a storage requirement of 45 million bytes, which is within the capacity of two modules of an IBM 2314.

Updating this file would probably be a once-daily batch operation, consisting of adding new records on the end if they represented new LC Card Numbers, inserting them in the proper cluster if other holdings records existed for that LC Card Number, and modifying the data elements of existing holdings records where changes were made. This last step would, in general, require rewriting the record, deleting the old one, and inserting the new one. The directory would be searched to determine the proper position for new records to be inserted, the new records would be sorted in the order of the directory addressed (not LC Card Number) and merged in during a daily file-rewrite operation. This rewrite operation would also create new address listings for the holdings file address portion of the LC Card Number Directory. These new address listings would be sorted in LC Card Number order (not directory-address order) and merged in during a corresponding file-rewrite operation to the holdings file portion of the LC Card Number Directory.

7.4 INSTITUTIONAL HOLDINGS DIRECTORY

At each Holdings File update period, a file could be written of new holdings' LC Card Numbers and the corresponding holding institution. This file could periodically be subdivided by institution, and each subfile sorted by LC Card Number to result in a file to be added onto individual institutions' holdings directories. For the initial period of collecting holdings records, however, where file size will be relatively small and the usage of individual institution directory files would be small, it would be simpler to perform an extraction from the regional holdings file as needed, either of full holdings records or of LC Card Numbers. All institutional directories would equal about four million bytes for 500,000 holdings records, since the institutional directories would merely be a list of LC Card Numbers.

7.5 LC CARD NUMBER DIRECTORY

This is a three-element directory containing an LC Card Number for every MARC record in the system; the address of the MARC record; and the address of the first holdings record of that LC Card Number, if any. This would require about eight million bytes for the half-million MARC records we are considering. We assume eight bytes for the LC Card Number and four bytes for each address. The four byte "address" would actually be an address surrogate convertible to cylinder number, track number, etc.

The directory is in LC Card Number order, and for purposes of MARC record access, must be updated weekly. For purposes of holdings access, it should be updated daily. If we assume half the MARC data base will have no corresponding regional holdings records, then there would be no space penalty for maintaining two separate directories for MARC and for holdings. The two directory approach would save space overhead when performing the daily holdings directory update since the LC Card Number - Holdings address directory file would be 3/8 the size of the combined LC Card Number - MARC Address-Holdings Address directory file, under the assumptions above. The penalty for two directories, however, would be an extra disc access when both MARC and holdings records were needed, as in the case where search in support of acquisitions or inter-library loan was performed. In these cases, we have reached the conclusion that the proper response to almost any information request concerning the Holdings file will require an access to the MARC file as well to obtain confirming data (e.g., author-title, imprint, edition statement, call number, etc.). We considered briefly the thought of always inserting a call number in the holdings record (local, or LC if no local) on the basis that this was the most frequently needed item. Full confirmation, however, requires more, and we did not wish to have duplicate information in the two main files. (The LC Card Number does exist in both, but since this is the primary access point to both files, its inclusion in the holdings file, while redundant, does simplify the creation of directory files.)

For the on-line system, therefore, we recommend a two-address LC Card Number directory. In the File Linkage diagram of Figure 4, we show the LC Card Number Directory preceeded by a module directory. We assume here that the files, and their immediate directories, may be divided into separate sections of memory for more efficient access.

7.6 CODE INDEX

The Code Index, shown in Figure 5, associates a code word extracted from an author-title description, in any word position, with the starting address of the list of LC Card Numbers that correspond to records having that code word in that position. As shown in Figure 5, we estimate the occurrence of 50,000 word types, and a maximum full index space of 14.35×10^6 bytes. In practice, this would not exceed 6.35×10^6 bytes, since words of a particular class can occur in, at most, three positions. We retain the full index estimate on the basis that we may wish to expand the word selection process beyond that of our earlier report.[33]

Another interesting approach to the creation of a Code

Index is contained in the RECON report[2], and is based on the work of Coyle and Stewart for that project. This is the "Permanent Index" which creates a code entry for all 398,034 possible one, two, three, and four letter codes, and has space for the starting address (link) of each code in each of eight positions. The four letter eight position approach is due to Ruecking[41]. By comparison, this index occupies 12.8 x 10^6 bytes. The advantage of the "Permanent Index" is that address calculation is possible for the index position of any code word, and it need never be updated except to add or change link addresses. The disadvantage in this writer's opinion is that it limits one to low-resolution four letter alphabetic codes.

For the planning purposes of this report, our size estimates are adequate for either approach.

7.7 OCCURRENCE LIST

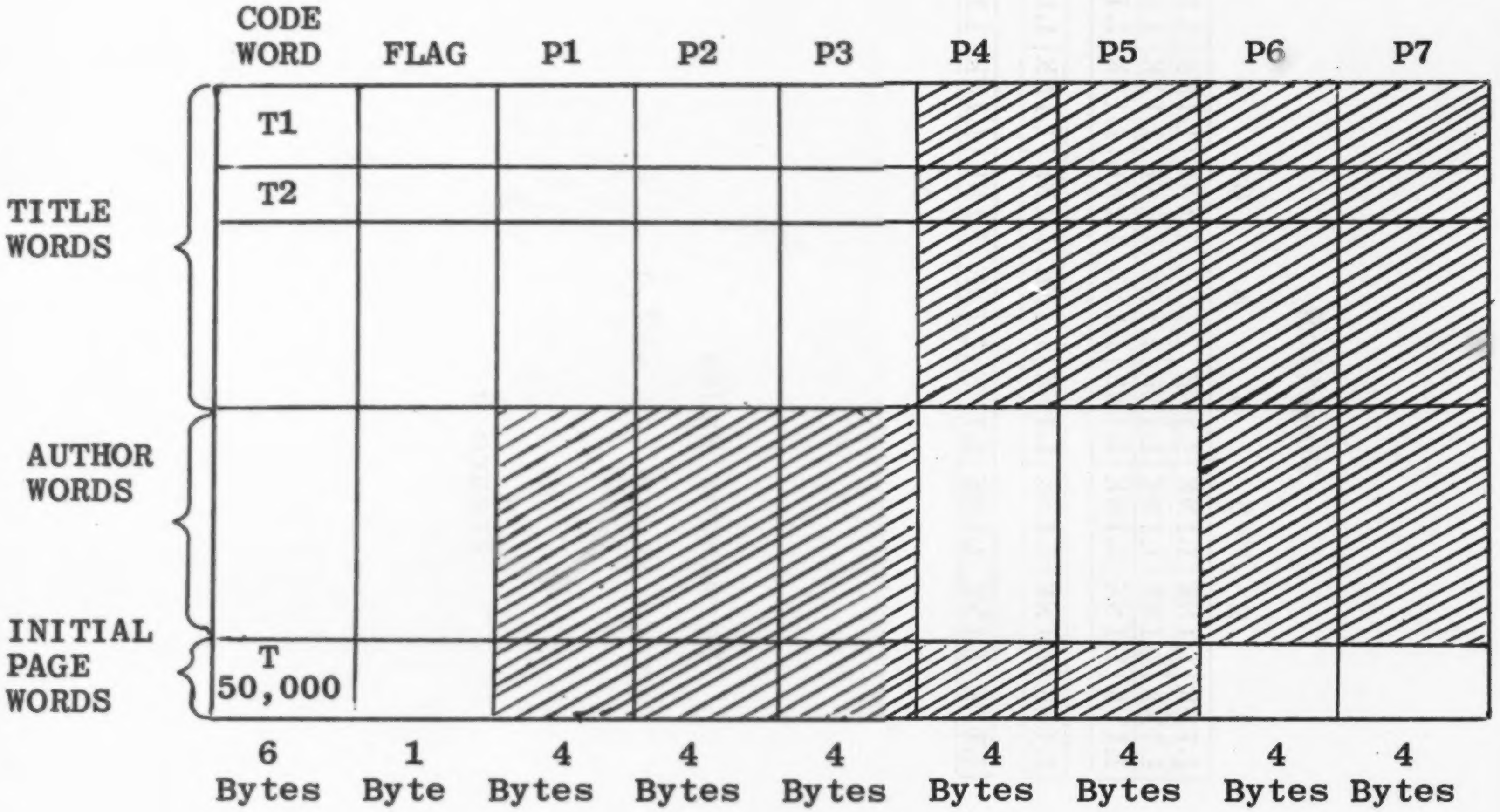
The Code Index points to the Occurrence List where the LC Card Numbers of records having the desired word in the desired word position are accessed. The structure of the occurrence list is a critical decision for retrieval purposes, since it is strongly influential on the access rate.

The two basic structures possible are threaded lists, wherein list cells contain the address of the next list entry of the desired type; and inverted lists, wherein list cells contain the record addresses in clusters, according to type.

Figures 7 and 8 show these two types of lists. In the threaded list, a list entry consists of an LC Card Number and seven cells containing the address of the next list entry (if any), for which the word in that cell position occurs again. In the inverted list, a list entry consists of the collection of LC Card Numbers that contain a given word in a given position. Intermediate versions of these structures exist (e.g., controlled-length threaded lists, cellular threaded lists), but it is sufficient here to compare the two basic structures.

In storage space, the threaded list requires up to 18.5 x 10^6 bytes. Less would be necessary in practice if variable length list entries were used and a data flag indicating which cells were present for each entry.

The inverted list, for the same application, requires 28 x 10^6 bytes. This is not a valid comparison in general, however, since normally a threaded list would require PR + R address cells, and an inverted list would require only PR. The difference in this application, however, is that link


CODE WORD
FLAG
P1
P2
P3
P4
P5
P6
P7
T1
T2
T 50,000
TITLE WORDS
AUTHOR WORDS
INITIAL PAGE WORDS
6 Bytes
1 Byte
4 Bytes
4 Bytes
4 Bytes
4 Bytes
4 Bytes
4 Bytes
4 Bytes

CODE INDEX

N codes in P positions for R records
$N \approx 50{,}000 \quad P = 7 \quad R = 500{,}000$
$\text{Size} \approx 4PR + 7N = 14.35 \times 10^6$ Bytes

Figure 5

	Position							
	1	2	3	4	5	6	7	8
Code Grp.1(A)	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK
Code Grp.2(AA)	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK
Code Grp.3(AAA)	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK
Code Grp.n(AMER)	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK
Code Grp. 398,034 (ZZZZ)	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK

Permanent Index

(after Avram, et al[2].)

Figure 6

THREADED LIST

	LC CARD #	Flag	P1	P2	P3	P4	P5	P6	P7
1									
2									
. . .									
R									

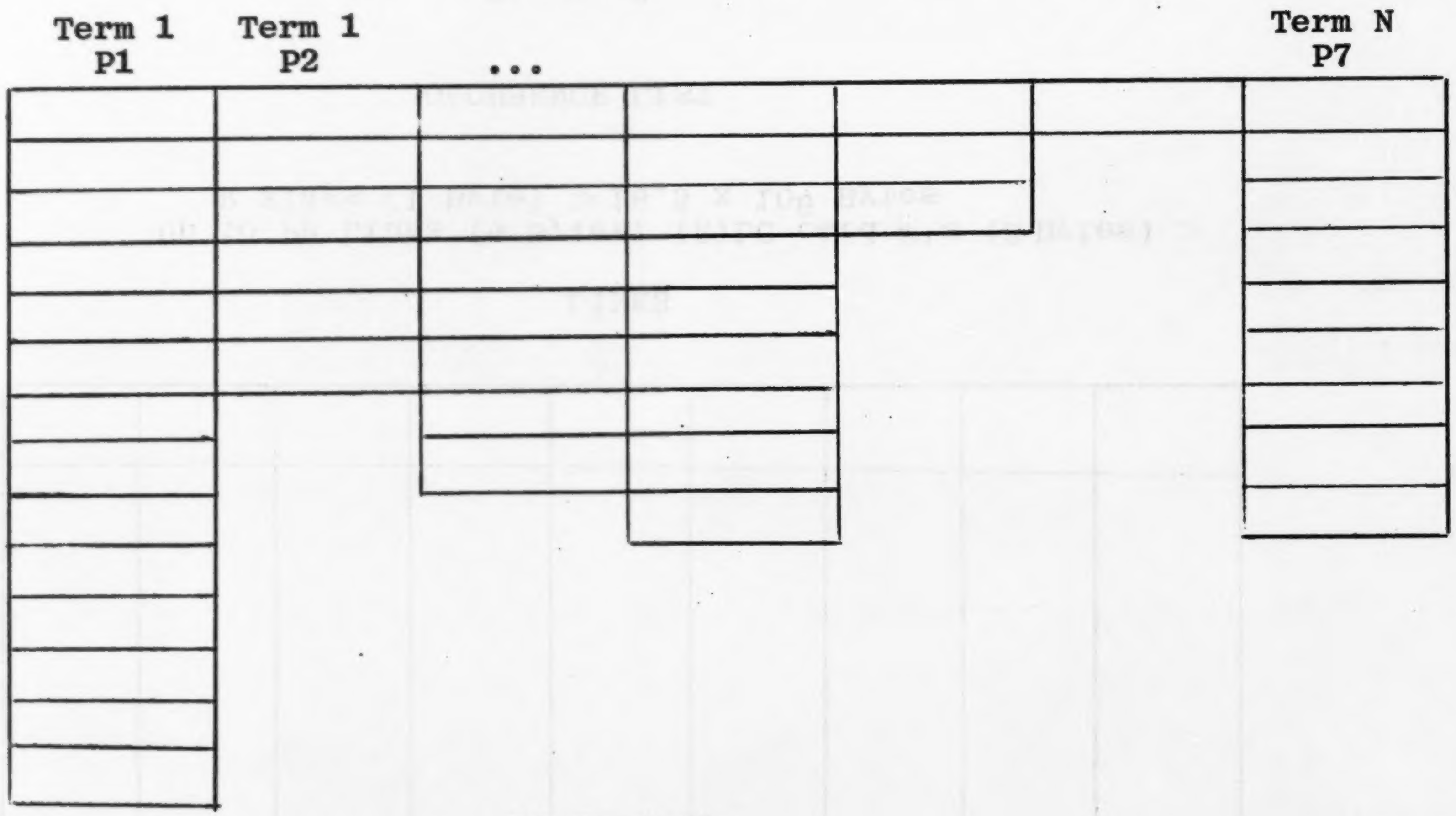
LINKS

Up to PR Links (4 Bytes) (R)LC card #'s (8 Bytes)
R Flags (1 Byte) $\approx 18.5 \times 10^6$ Bytes

OCCURENCE LIST

Figure 7

INVERTED LIST


Term 1
P1
Term 1
P2
...
Term N
P7

LC Card #'s

PR LC Card #'s
distributed in up to PN lists
(3.5 x 10^6 LC card #'s; less than .35 x 10^6 lists)
$\approx$ 28 x 10^6 Bytes

Figure 8

addresses are considered to occupy four character positions, and record addresses (LC Card Number) occupy eight character positions.

Without going too deeply into access methods, it is sufficient to say that the inverted list was chosen for this application on the basis of obtaining clustered, rather than distributed LC Card Numbers, since disc storage, in general, will require one access per threaded list link, whereas an inverted list entry of over 10,000 LC Card Numbers can be accessed in a single disc cylinder.

We are dealing with word accessed files and we can therefore expect extreme variation in word occurrences, according to Zipf's law, with the consequence of extremely long occurrence lists of commonly used words.

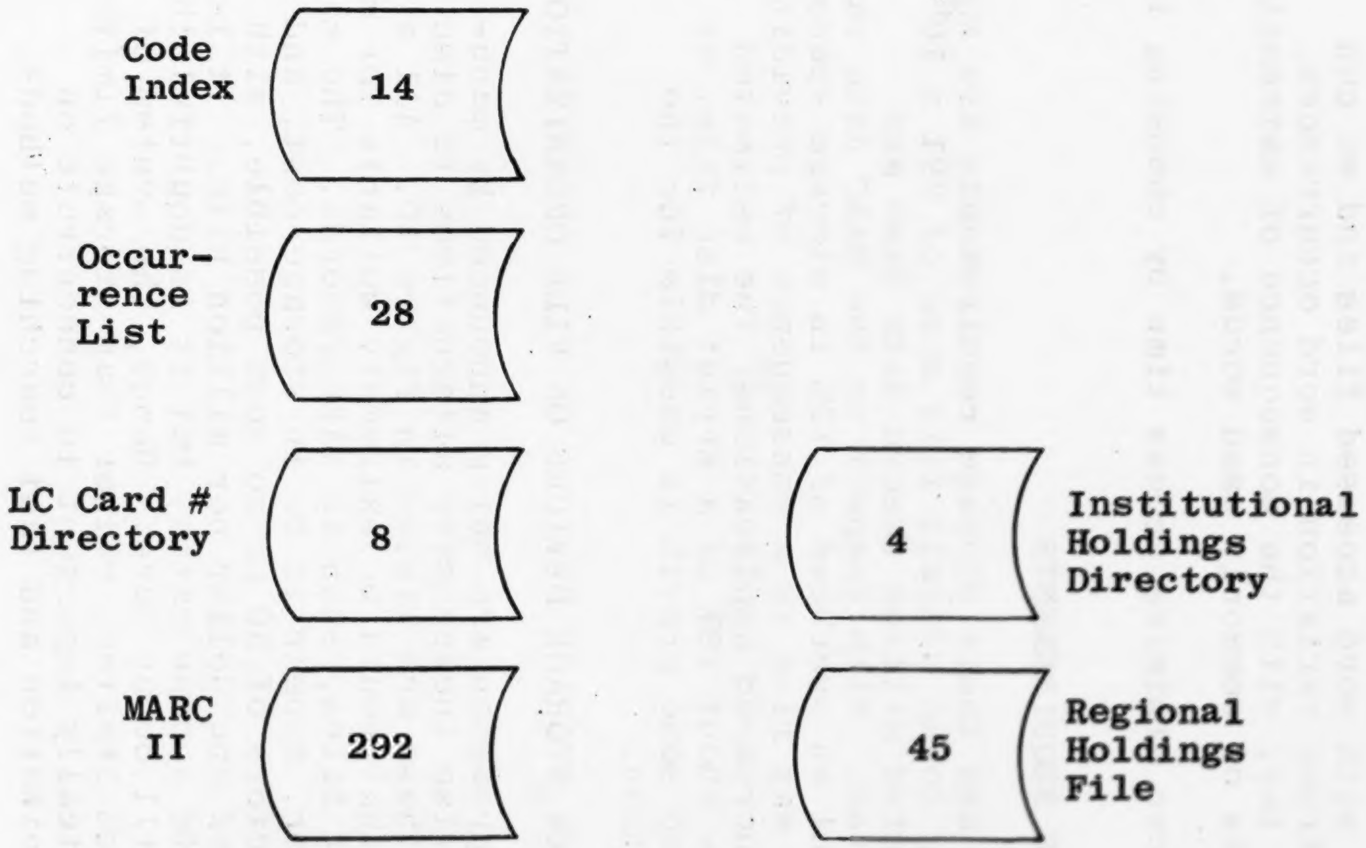
Therefore, we can minimize access time by choosing the inverted list.

7.8 OVERALL STORAGE REQUIREMENTS

The main files and their storage requirements are shown in Figure 9, summing to an overall file size of 391×10^6 bytes for the projected million record data base and supporting directories. With respect to the MARC data base, directories represent an overhead of 17% in storage space. While this overhead may rise as a consequence of providing greater access or increased applications; the estimated total storage is now about 78% of a Bryant disc file, or 84% of two 2314's, so some growth is possible for the projected configuration.

7.9 INFLUENCE OF NEW STORAGE DEVICES ON FILE ORGANIZATION

Several new approaches are being announced by manufacturers which promise inexpensive alternatives to disc storage. Three of these are listed in Figure 10. All are read-only memories that would be extremely suitable for mass storage of permanent files, such as MARC records. The main improvements, however, appear to be in storage cost, and here improvement factors of 50 or so seem possible, with costs in the order of one dollar per million bits. It is too early to evaluate access rates, but it is doubtful that vast improvements will occur here. Hence, the system of the future becomes access limited, rather than storage limited, and it remains critically important to concentrate on efficient file organization and fast searching methods.


Code
Index
14
Occur-
rence
List
28
LC Card #
Directory
8
MARC
II
292
4
Institutional
Holdings
Directory
45
Regional
Holdings
File

MAIN FILES

Size in Bytes x 10^6
Total approx. 391 x 10^6 Bytes

Figure 9

NEW DEVICES (READ ONLY) $\approx 10^6$ bits/$

Photo-Mem

1 PDC = 10×10^6 bits; costs 25¢ for 4" x 6" film chip
1 Foto-Data cell = 100 PDC's = 10^9 bits
1 FM-390 = 250 Foto-Data Cells = 250×10^9 bits; costs $300,000

UNICON 690 (Precision Instrument Co.)

10^{12} bits; $\$10^6$

DATAPLAYER (EG&G)

10×10^6 bits/7" record
(5×10^6 bits/side)
850 MARC records/5 min

Figure 10

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Appendix IV

Technical Description of Programs

PROGRAM WRITEUP #10-J-23

TO: PDP-10 Users

FROM: Brent Byer

SUBJECT: Technical Description - Holdings and MARC Processor (HAMP)

DATE: July 29, 1970

SCOPE

HAMP will match/merge a sorted NELINET MARC II mag tape file with a sorted disc file containing request records and new MARC II records. A disc file of matched requests (containing both MARC II and request record data) will be generated to produce cards and labels. A new mag tape will be generated containing old MARC II from tape, new MARC II records from disc, and both old and new unmatched requests; also, newly-created "holdings records" (matched requests) will be included on this tape in addition to the current holding records; this tape becomes the new input tape for the next run.

I. FILES - the HAMP program requires three files:

A. LID.MAC - standard library definitions; assembled in front of HAMP.MAC (below).

B. HAMP.MAC - contains all source code (MACRO-10) including:

1. HAMP definitions

2. Main program

3. End of job processing

4. Subroutines

5. Tables

C. UUOL.REL - latest UUO Library file; to be link-loaded with the output from the assembly of LID.MAC + HAMP.MAC.

TECHNICAL DESCRIPTION - HAMP

II. HAMP Definitions:

A. All software I/O channels are defined symbolically with three alphas, 1st one "C" (e.g. CMI = 0; mag tape I/P channel).

B. All accumulators are defined symbolically with three alphanumerics, 1st one "A" (e.g. AD1 = 1; accum. for 1st word, disc I/P compare).

C. Mag tape I/P and O/P density and parity are defined symbolically as three alpha, 1st one "D".

D. INTERNals and EXTERNals to link with the UUO package are included.

III. SUBROUTINE PHILOSOPHY:

All subroutines included in HAMP are called by a "DO" (PUSHJ 16,).

IV. BUFFER AND COMPARE ACCUMULATORS:

A. HAMP has three buffers as follows:

1. Mag tape I/P Buffer - contains the last record read from mag tape.

2. Disc I/P Buffer - contains the last record read from the disc input file.

3. "Output" Buffer - always contains the most recently encountered L.C. record.

B. Associated with each of the two I/P buffers are three permanently assigned "compare" accumulators (CA's). These CA's are filled from the first three words of the Sort Key (see Appendix A) each time a record is read. Associated with the single O/P buffer are two permanently assigned CA's. These two CA's contain the first two words of the Sort Key of the LC record in the O/P buffer.

1. Disc I/P CA's ⟶ "AD1", "AD2", "AD3"

2. Mag I/P CA's ⟶ "AM1", "AM2", "AM3"

3. O/P Buffer CA's ⟶ "AB1", "AB2"

C. CA's 1 and 2 contain the full L.C. card number; CA3 contains the Library prefix portion of the Request number in the right half, zeros in the left half.

V. COMPARING PHILOSOPHY:

A. The words obtained from the Sort Key must be "fudged" to create a logical (absolute) compare rather than an arithmetic compare as done by the hardware instructions, i.e., 36 bits of magnitude, no sign bit. This is easily accomplished by complementing the sign bit (bit 0) of words before comparing them.

B. The CA's of the Mag I/P and Disc I/P buffers are compared to decide which path the program should take. If they are not equal, the action taken is simply to output the lower record to Mag tape. If equal, a certain amount of further processing must take place.

C. Only if all CA's of one record are equal to another does HAMP have to examine the remaining Sort Key words in the buffers.

VI. INPUT ROUTINES: Both the mag tape (800 BPI, odd parity) and Disc I/P routines function in the same manner as follows:

A. Perform the actual I/O transfer of one input record (variable length, maximum 100 word map, 3000 data characters plus Sort Key).

B. Normal Condition:

1. Check that Sort Key words 1, 2 and 3 are equal to or greater than the previous record from the same file; if less, abort the job - a file is out of sequence! If equal, and the file is Disc I/P, it is a "duplicate record", an error message is typed and the record ignored.

2. Make Sort Key words 1, 2 and 3 "absolute" and move to the proper CA's.

3. Look up the library prefix (CA3) in the prefix table (which includes library L.C. "blank/blank/blank") and add to library's input counter if found. If not, add to "unknown" counter, O/P an error record and get next record.

C. Error I/P Transfer Conditions:

1. Pick up the I/O error flags and print on teletype.

2. Halt. If continued, read next record.

D. End of File Condition:

1. Move the highest possible compare value to the three CA's for that I/P file.

2. This will force all I/P and O/P to be from the other I/P file until it too reaches an EOF condition (only if CA's 1, 2 and 3 are all equal do we have to check for an end of job condition).

VII. MAIN PROGRAM FLOW:

A. Initialization

1. Clear totals.

2. Set up Pushdown List Pointer.

3. Initialize cost routine; get and store system date.

4. Set I/P buffer CA's to lowest possible value.

5. Do file definitions for:

(a) Disc and Mag I/P files

(b) Mag O/P File

(c) Disc Combined Match O/P File

6. Rewind I/P and O/P mag tapes.

7. Read one record each from Mag and Disc I/P Files.

B. I/P - to - I/P Compare

1. Compare the Mag I/P buffer to the Disc I/P buffer.

2. If equal, check for end-of-job.

3. If Mag is lower, do the appropriate processing (see flowchart).

4. If Disc is lower, do appropriate processing (see flowchart).

5. Fill emptied input buffer(s) and loop.

C. End of Job Processing

1. Will type out on the teletype the totals by library for input, output, matched and error records. (If there were no records for a library, its print-out is suppressed).

2. Both I/P and O/P mag tape files are closed and both tapes are rewound.

3. All disk I/P and O/P files are closed and HAMP returns to the Monitor.

VIII. TABLES:

A. The only look-up table necessary is one whose left half has a one-to-three character library prefix code. The right half of each table word is used as an input record counter (TABLIB).

B. A second table of counters with one word per library corresponding to the above table is used to accumulate the other totals (TABLER).

IX. ASSEMBLING AND LOADING INSTRUCTIONS:

A. PDP-10 Console Commands:

```
.COMPILE LID+HAMP
.R LOADER
*HAMP,UUOL/L$
.SAVE dev HAMP
```

B. EXPLANATION

1. The HAMP.MAC symbolic file must always be assembled with the current library definitions (LID.MAC) file.

2. The HAMP.REL file must always be loaded with the current UUO Library (UUOL.REL) file in "library search" mode (/L).

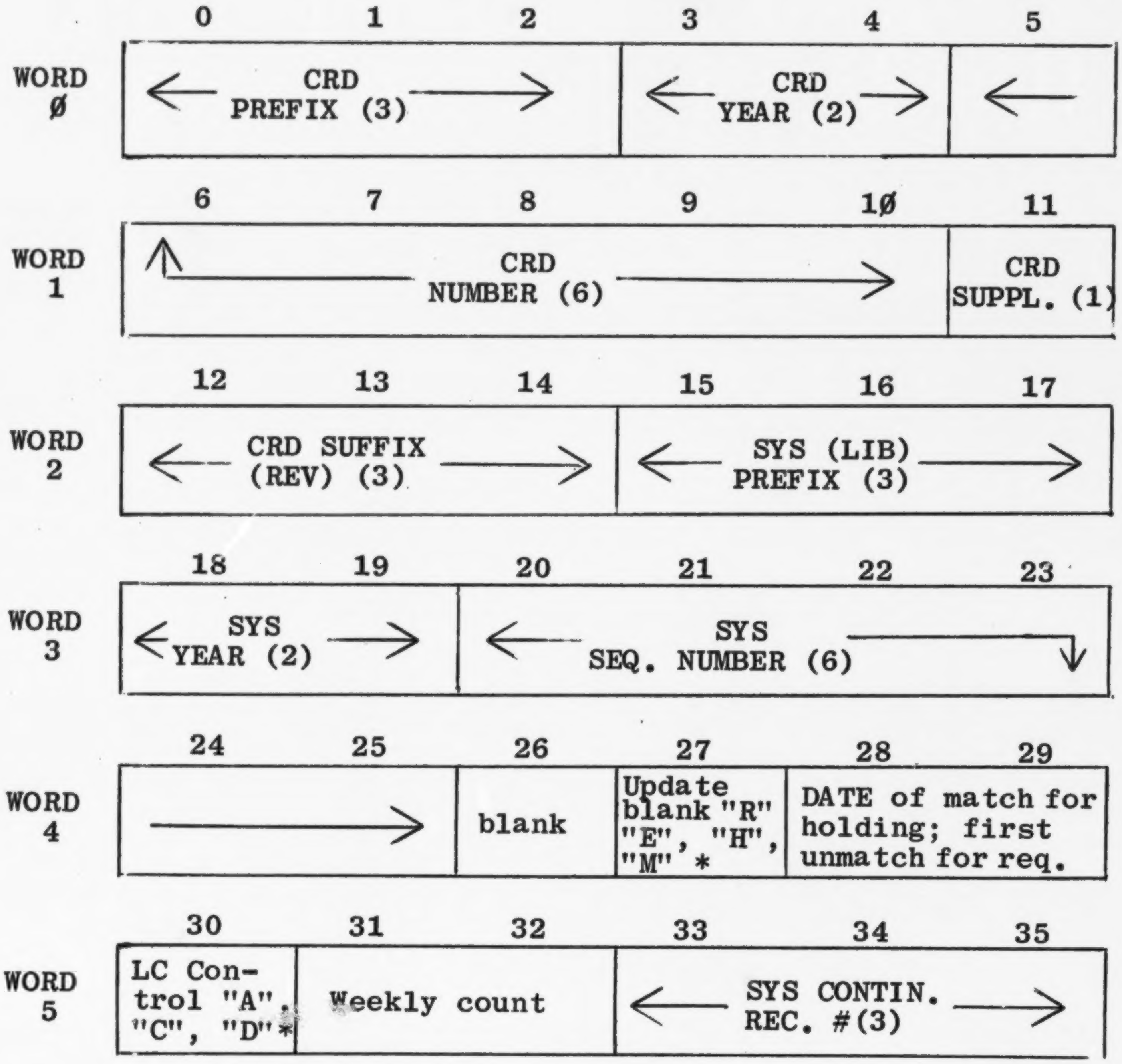
4

APPENDIX A

SORT KEY

(6 words - 36 chars.)

CHARS. ARE 6-BIT ASCII



WORD												
WORD 0	0	1	2	CRD PREFIX (3)	3	4	CRD YEAR (2)	5	←			
WORD 1	6	7	8	9	10	CRD NUMBER (6)	11	CRD SUPPL. (1)				
WORD 2	12	13	14	CRD SUFFIX (REV) (3)	15	16	17	SYS (LIB) PREFIX (3)				
WORD 3	18	19	SYS YEAR (2)	20	21	22	23	SYS SEQ. NUMBER (6)				
WORD 4	24	25	→	26	blank	27	Update blank "R" "E", "H", "M" *	28	29	DATE of match for holding; first unmatch for req.		
WORD 5	30	LC Control "A", "C", "D" *	31	32	Weekly count	33	34	35	SYS CONTIN. REC. #(3)			

MARC records (i.e., bibliographic records) are blanks in all SYS positions 15-35

REQ records are non-blank

* see Appendix B for explanation of functions

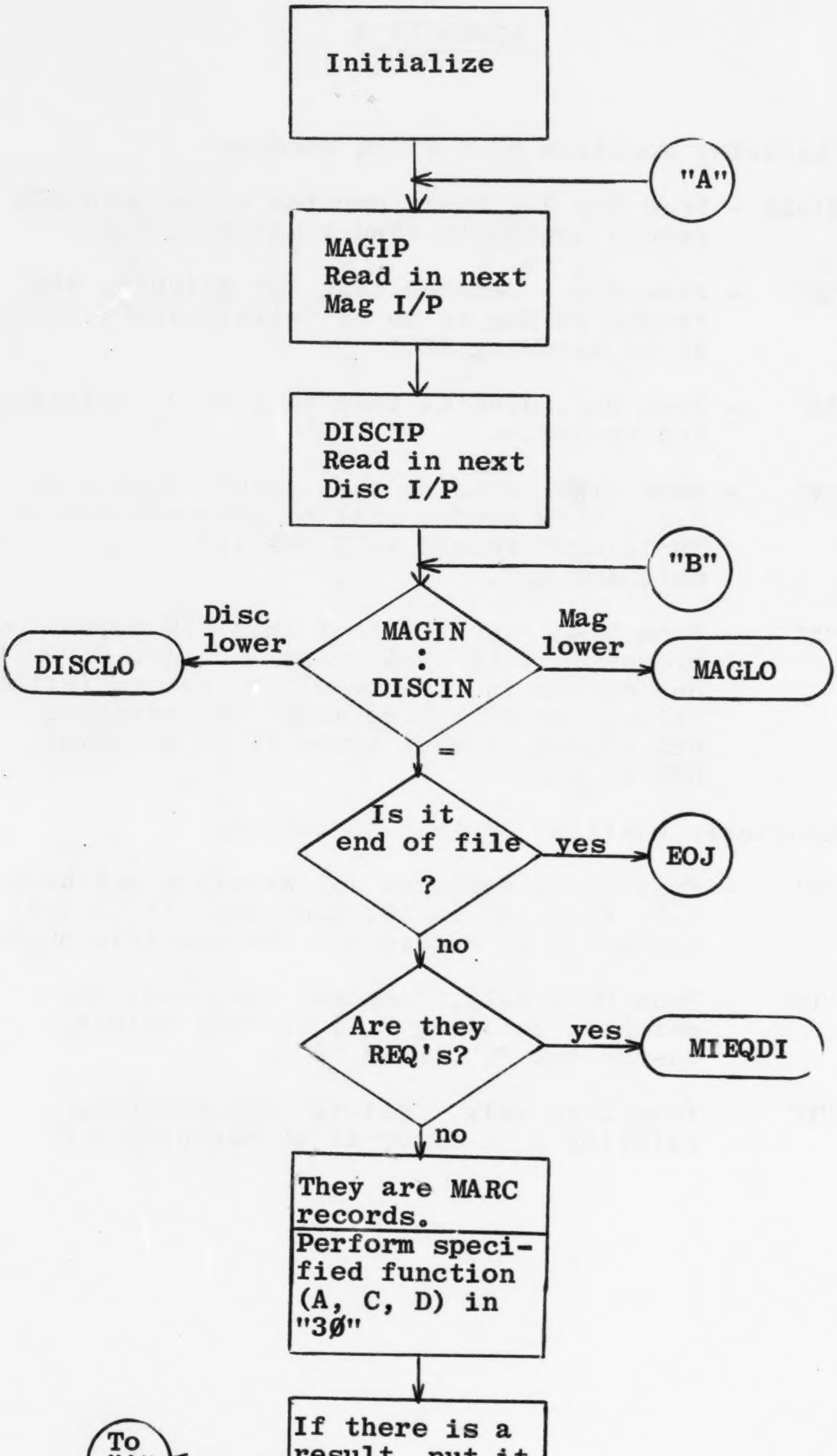
APPENDIX B

I. Character Position 27 for REQ records

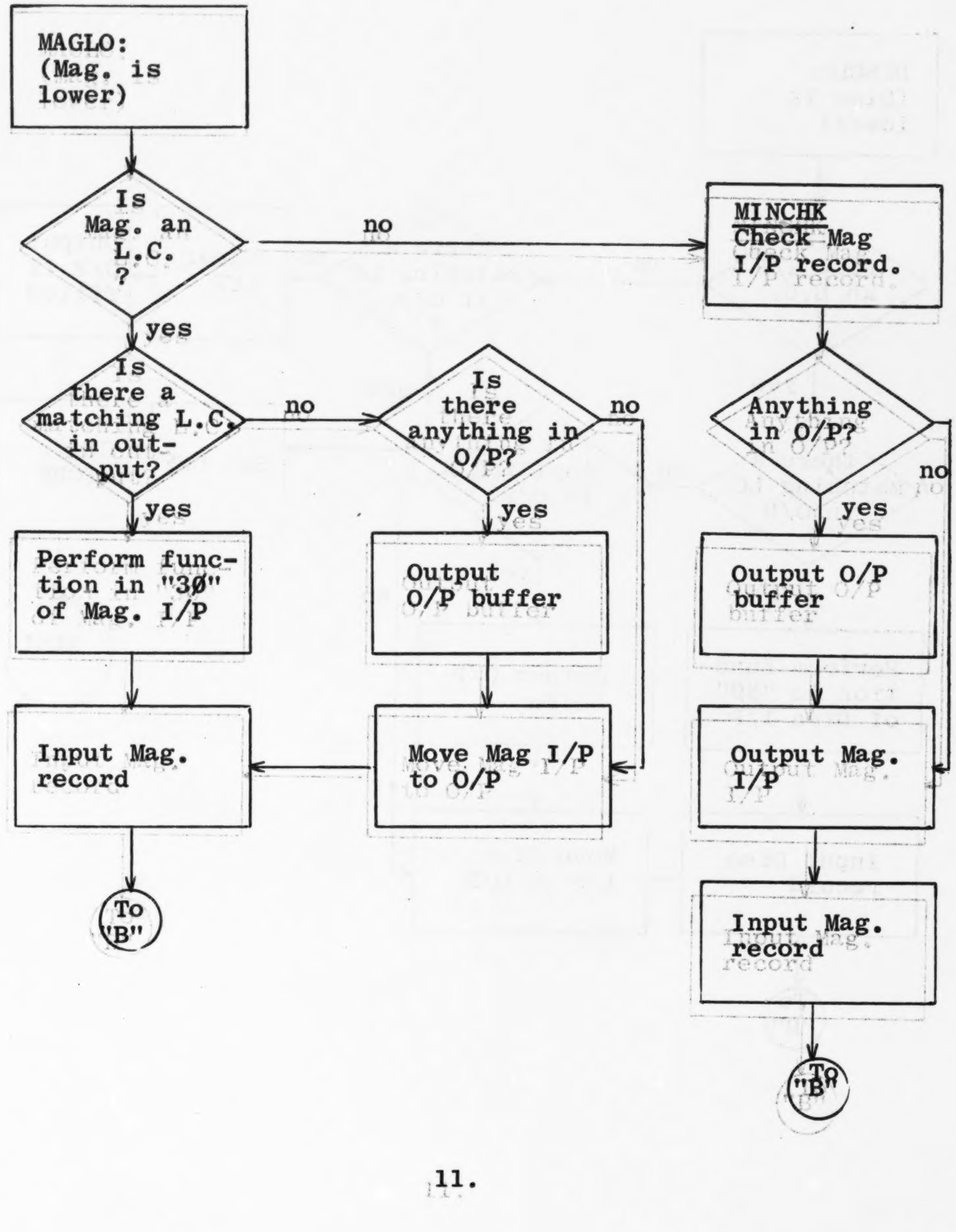
Blank	- From Mag and Disc, denotes a standard REQ record hoping to find a matching L.C.
"E"	- From Disc, denotes that the matching REQ record on Mag is to be "eliminated"; error if no matching REQ.
"H"	- From Mag, denotes that this is a "Holdings" REQ record.
"M"	- From Disc, denotes that upon matching an L.C., CLPP output will be produced but no "Holdings" record will result; error if no matching L.C.
"R"	- From Disc, denotes that this REQ should be processed with a matching L.C. for CLPP if one exists and the resultant record (either "blank" or "H") "replaces" the matching REQ record on Mag; error if no matching REQ on Mag.

II. Character Position 30 in L.C. records

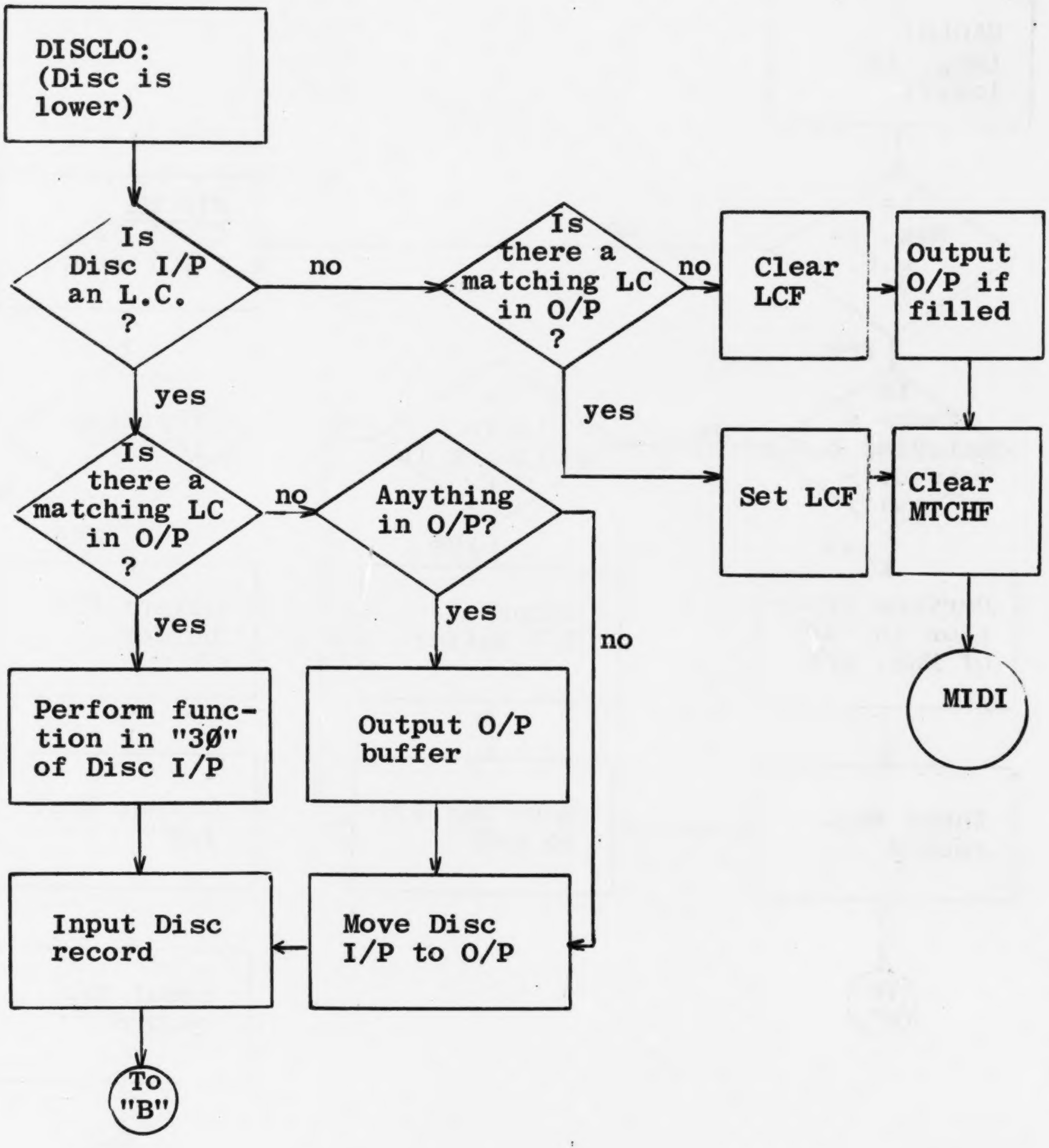
"A"	- From Disc, replaces any existing matching L.C. with "A" in 30; from Mag, it is the current L.C. record for the specific number.
"C"	- From Disc only, "change" (replace) the matching existing L.C; if none exists, assume the "C" is an "A".
"D"	- From Disc only, "delete" the matching existing L.C; error if no matching L.C.


Initialize
"A"
MAGIP
Read in next
Mag I/P
DISCIP
Read in next
Disc I/P
"B"
Disc
lower
DISCLO
MAGIN
:
DISCIN
Mag
lower
MAGLO
=
Is it
end of file
?
yes
EOJ
no
Are they
REQ's?
yes
MIEQDI
no
They are MARC
records.
Perform speci-
fied function
(A, C, D) in
"30"
If there is a
result, put it
in output
buffer.
To
"A"

MAGLO

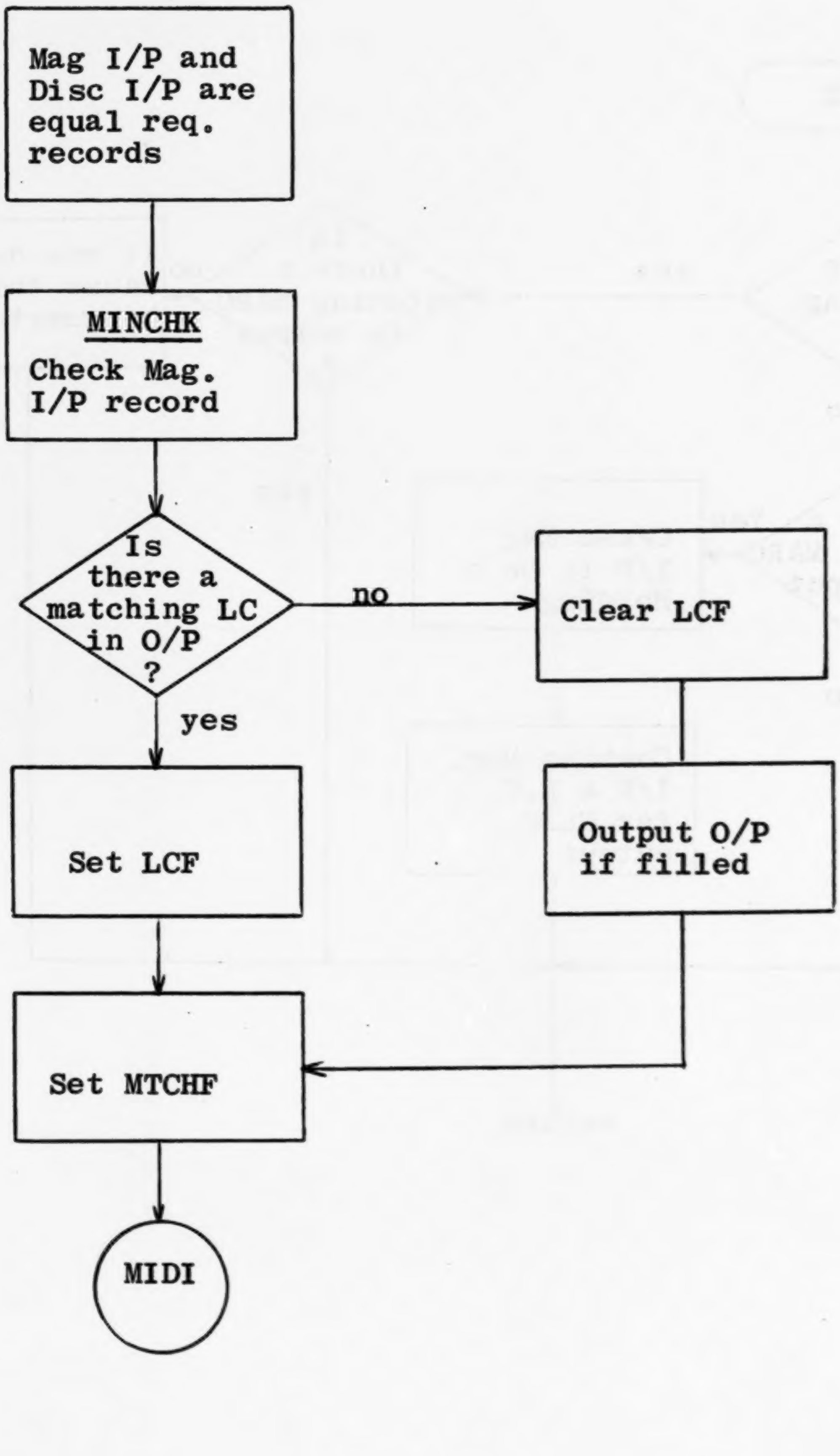

MAGLO:
(Mag. is
lower)
Is
Mag. an
L.C.
?
no
MINCHK
Check Mag
I/P record.
yes
Is
there a
matching L.C.
in out-
put?
no
Is
there
anything in
O/P?
no
Anything
in O/P?
no
yes
yes
yes
Perform func-
tion in "30"
of Mag. I/P
Output
O/P buffer
Output O/P
buffer
Input Mag.
record
Move Mag I/P
to O/P
Output Mag.
I/P
To
"B"
Input Mag.
record
To
"B"

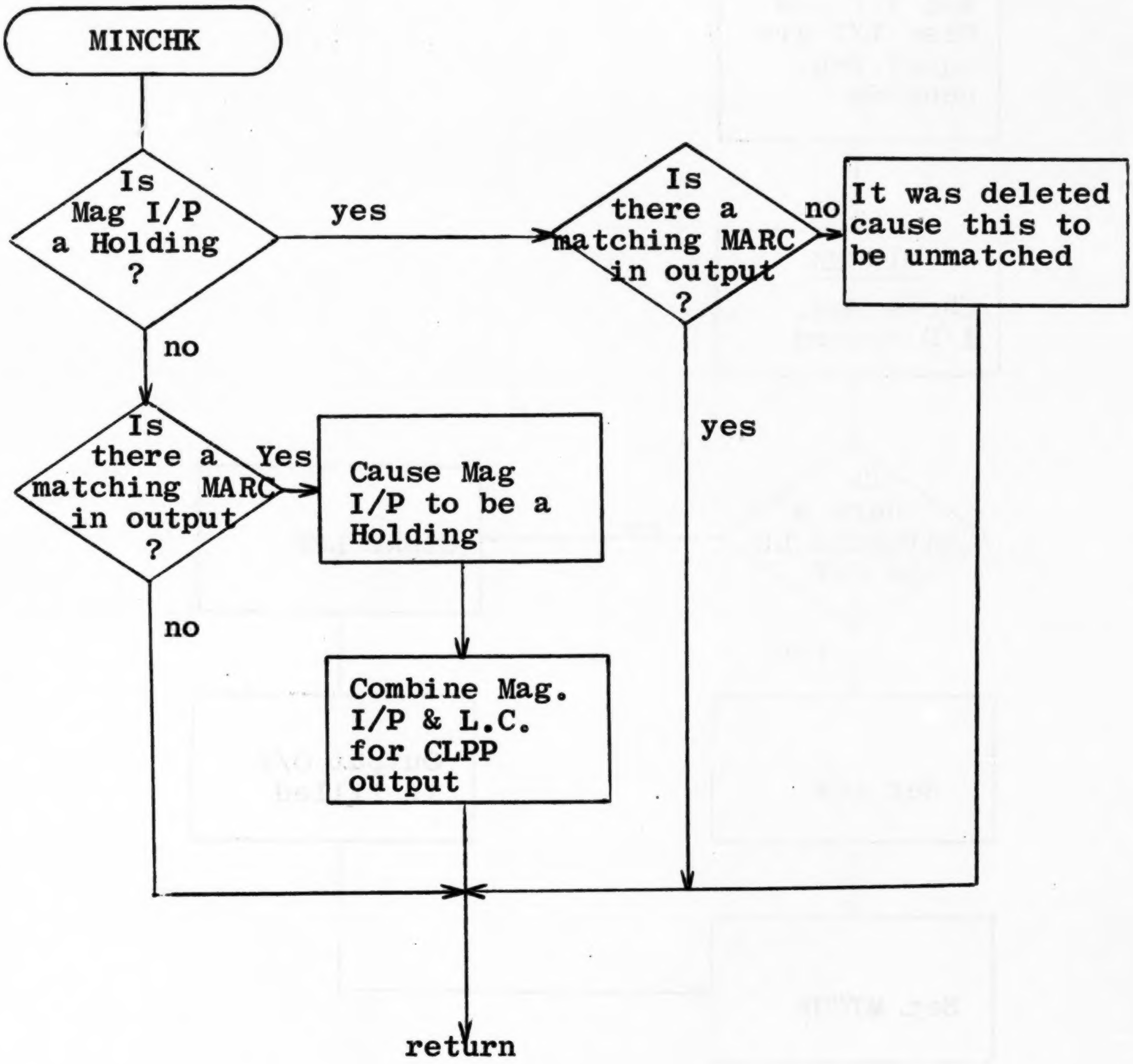
DISCLO



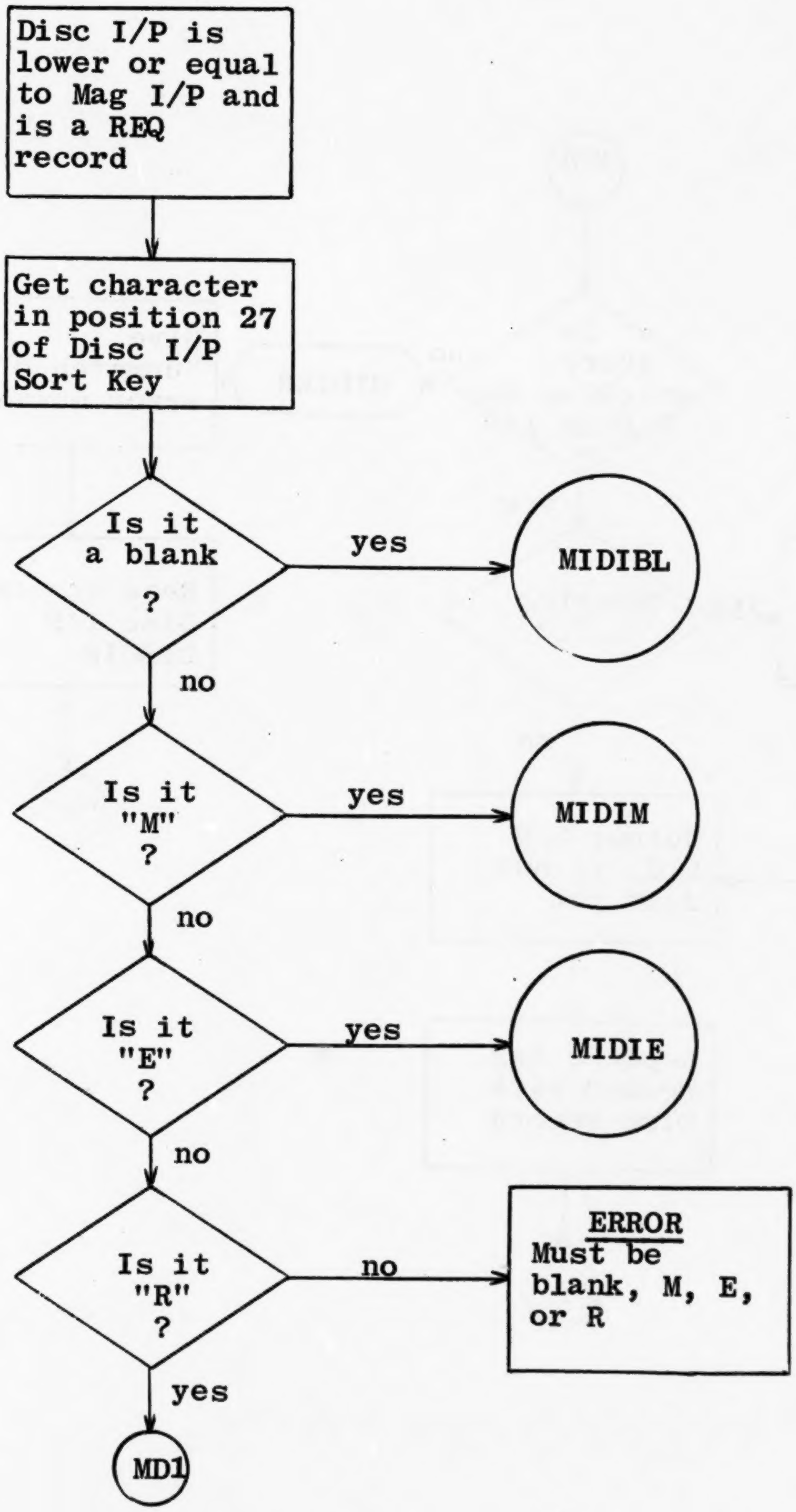
DISCLO: (Disc is lower)
Is Disc I/P an L.C. ?
no
yes
Is there a matching LC in O/P ?
no
yes
Clear LCF
Output O/P if filled
Set LCF
Clear MTCHF
MIDI
Is there a matching LC in O/P ?
no
yes
Anything in O/P?
yes
no
Perform function in "30" of Disc I/P
Output O/P buffer
Input Disc record
Move Disc I/P to O/P
To "B"

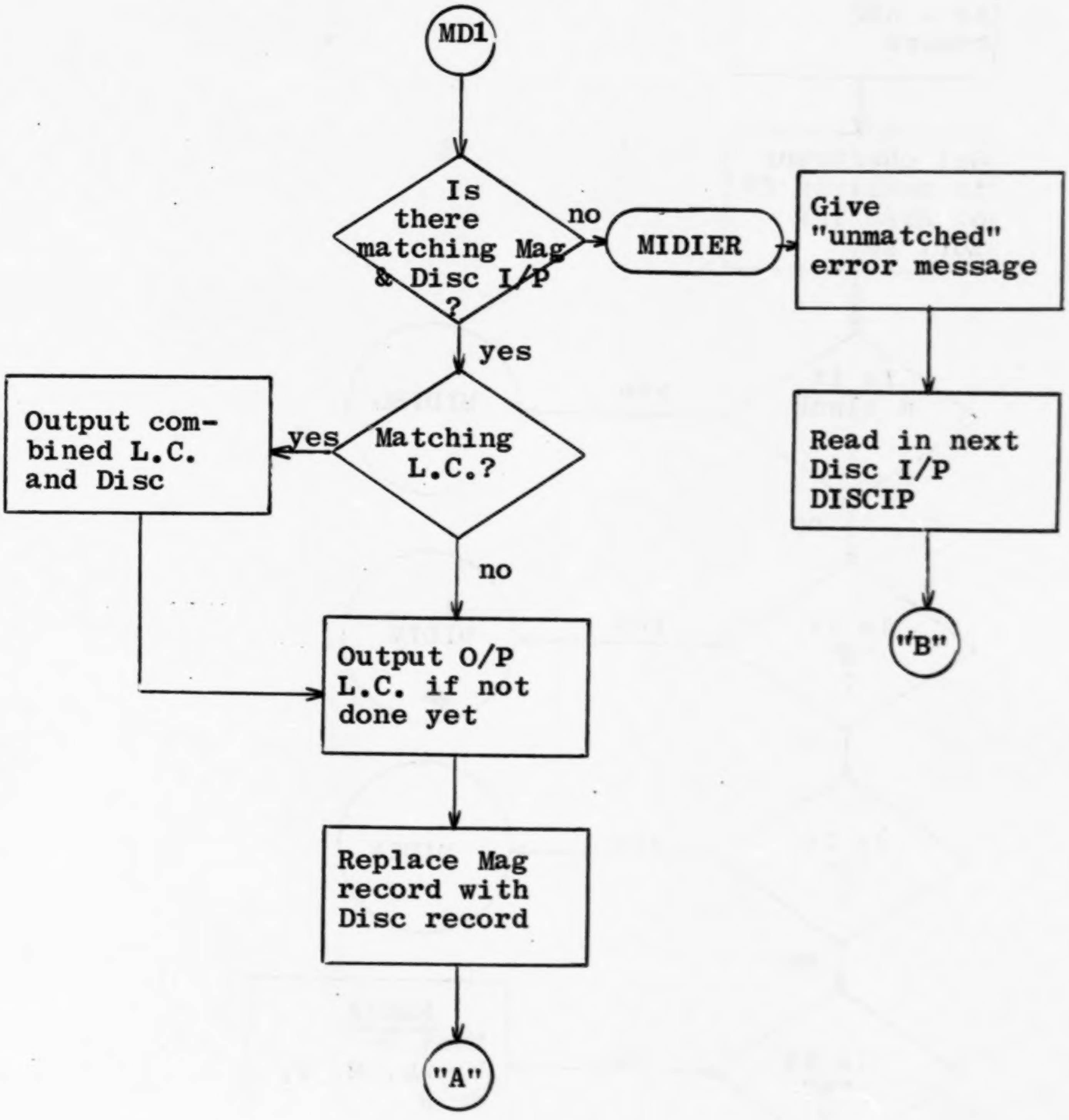
MIEQDI

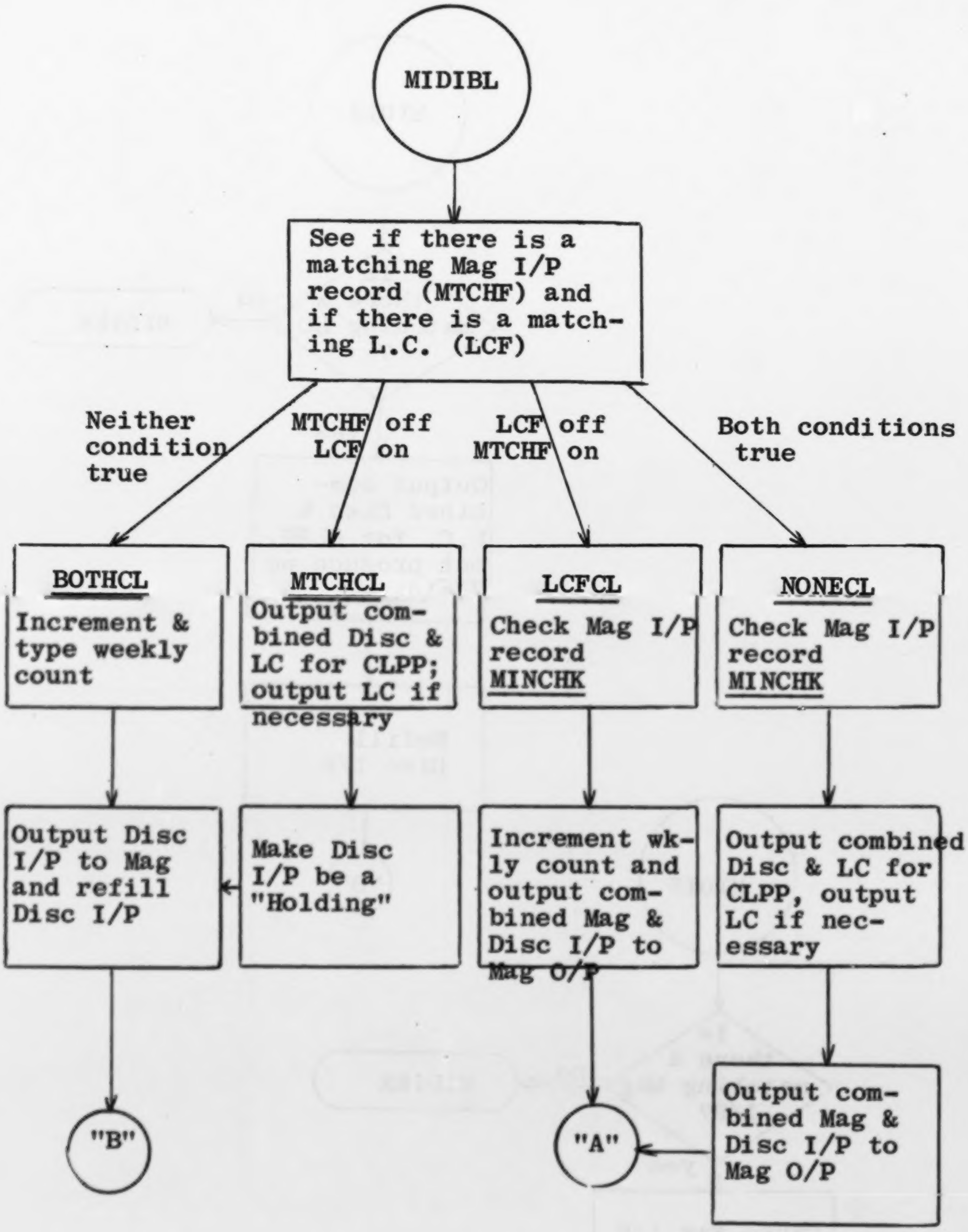

Mag I/P and Disc I/P are equal req. records
MINCHK
Check Mag. I/P record
Is there a matching LC in O/P ?
no
Clear LCF
yes
Set LCF
Output O/P if filled
Set MTCHF
MIDI

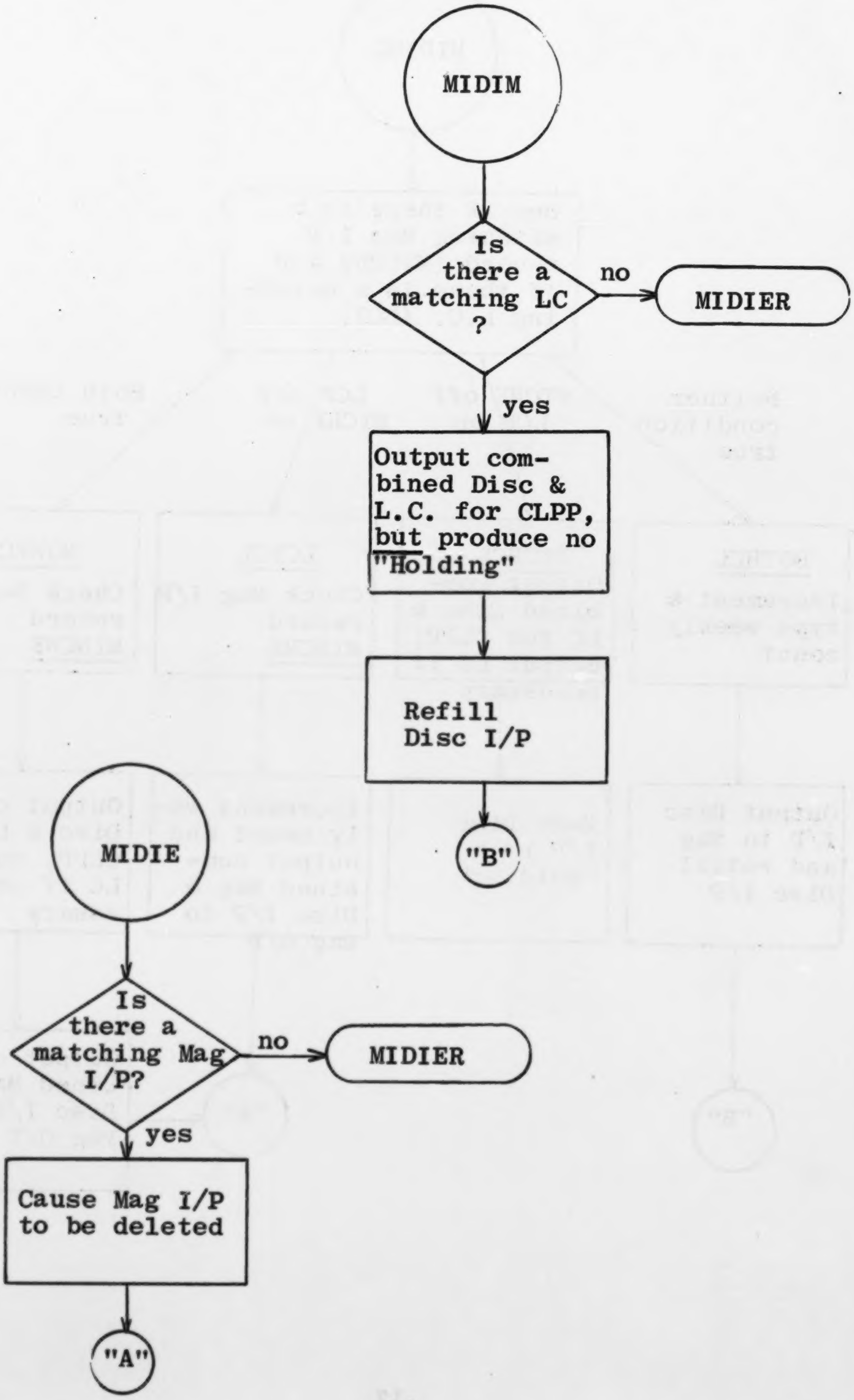

MINCHK
Is Mag I/P a Holding ?
yes
Is there a matching MARC in output ?
no
It was deleted cause this to be unmatched
no
Is there a matching MARC in output ?
Yes
Cause Mag I/P to be a Holding
yes
no
Combine Mag. I/P & L.C. for CLPP output
return

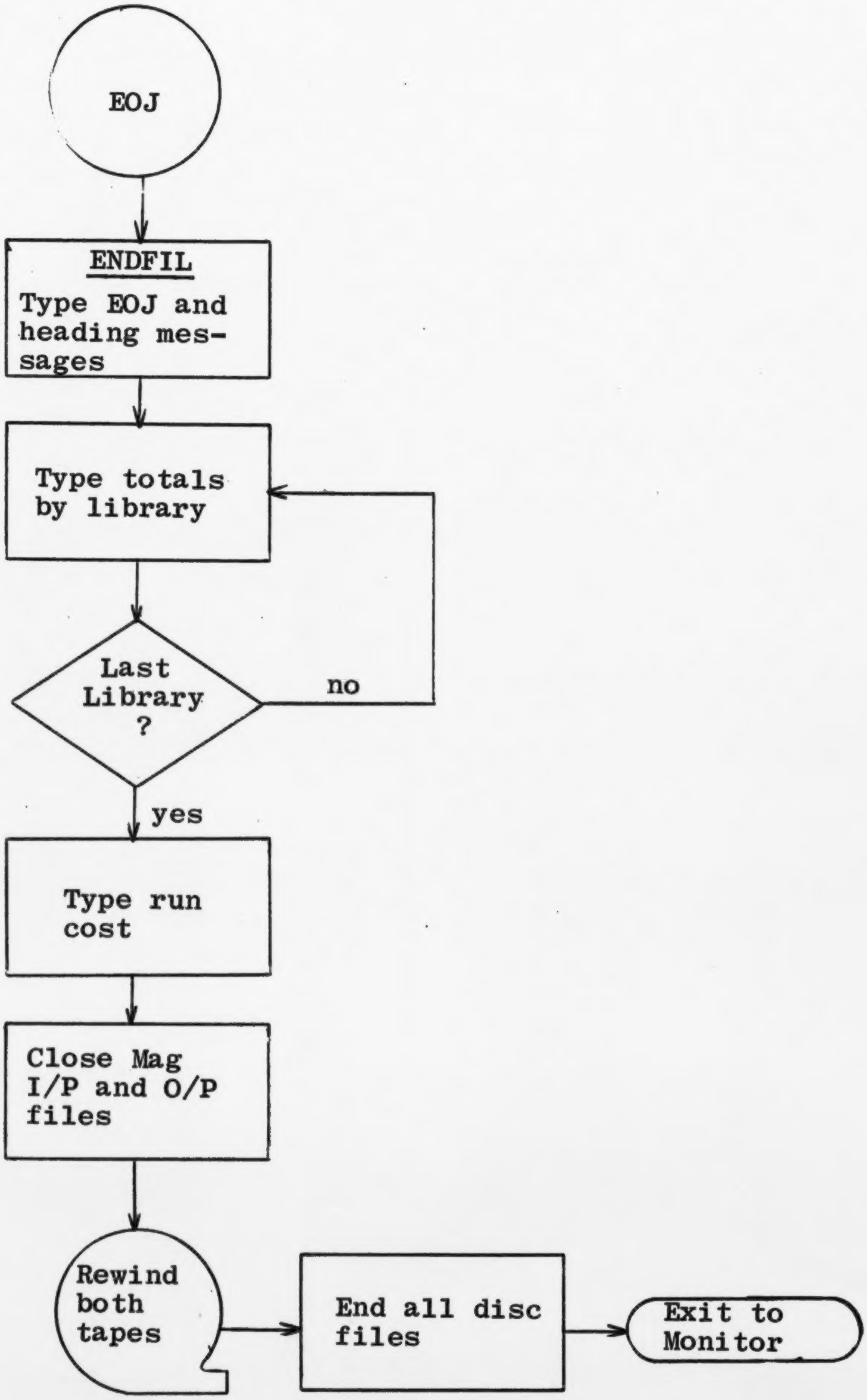
MIDI


Disc I/P is lower or equal to Mag I/P and is a REQ record
Get character in position 27 of Disc I/P Sort Key
Is it a blank ?
yes
MIDIBL
no
Is it "M" ?
yes
MIDIM
no
Is it "E" ?
yes
MIDIE
no
Is it "R" ?
no
ERROR
Must be blank, M, E, or R
yes
MD1


MD1
Is there matching Mag & Disc I/P ?
no
MIDIER
Give "unmatched" error message
Read in next Disc I/P DISCIP
"B"
yes
Matching L.C.?
yes
Output combined L.C. and Disc
no
Output O/P L.C. if not done yet
Replace Mag record with Disc record
"A"


MIDIBL
See if there is a matching Mag I/P record (MTCHF) and if there is a matching L.C. (LCF)
Neither condition true
MTCHF off LCF on
LCF off MTCHF on
Both conditions true
BOTHCL
Increment & type weekly count
MTCHCL
Output combined Disc & LC for CLPP; output LC if necessary
LCFCL
Check Mag I/P record MINCHK
NONECL
Check Mag I/P record MINCHK
Output Disc I/P to Mag and refill Disc I/P
Make Disc I/P be a "Holding"
Increment wkly count and output combined Mag & Disc I/P to Mag O/P
Output combined Disc & LC for CLPP, output LC if necessary
Output combined Mag & Disc I/P to Mag O/P
"B"
"A"


MIDIM
Is there a matching LC ?
no
MIDIER
yes
Output combined Disc & L.C. for CLPP, but produce no "Holding"
Refill Disc I/P
"B"
MIDIE
Is there a matching Mag I/P?
no
MIDIER
yes
Cause Mag I/P to be deleted
"A"


EOJ
ENDFIL
Type EOJ and heading messages
Type totals by library
Last Library ?
no
yes
Type run cost
Close Mag I/P and O/P files
Rewind both tapes
End all disc files
Exit to Monitor

PROGRAM WRITEUP #10-J-24

TO: PDP-10 Users

FROM: Brent Byer

SUBJECT: HAMR - Holdings and MARC Retriever

DATE: July 29, 1970

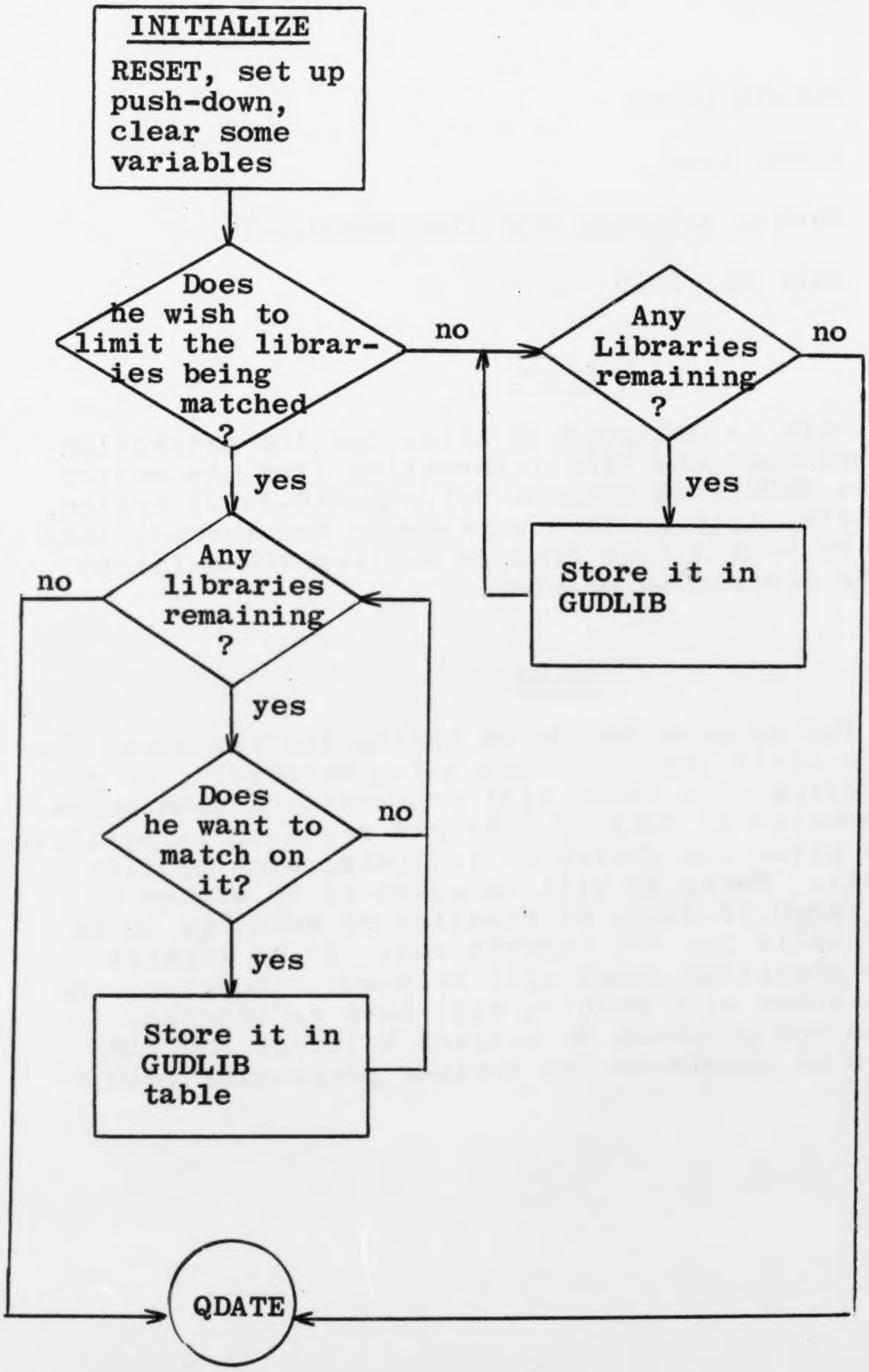
SCOPE

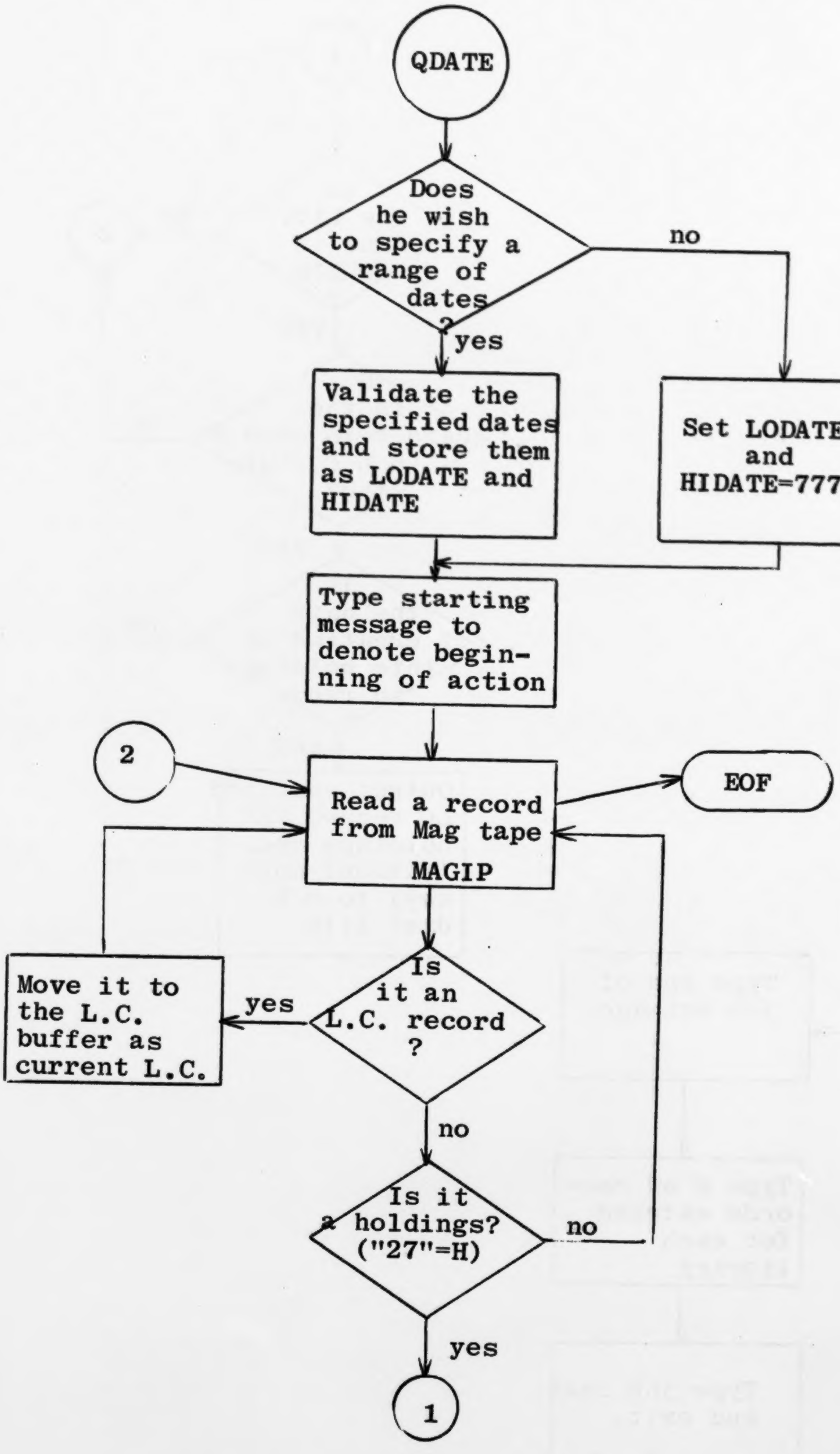
HAMR is designed to allow for the extraction of both "holding" and MARC information from the master tape of the HAMP (see Program Writeup #10-J-23) system. This extracted file is then sort-keyed and sorted, then processed by UNLIST (see Program Writeup #10-J-25) to produce the desired Union List.

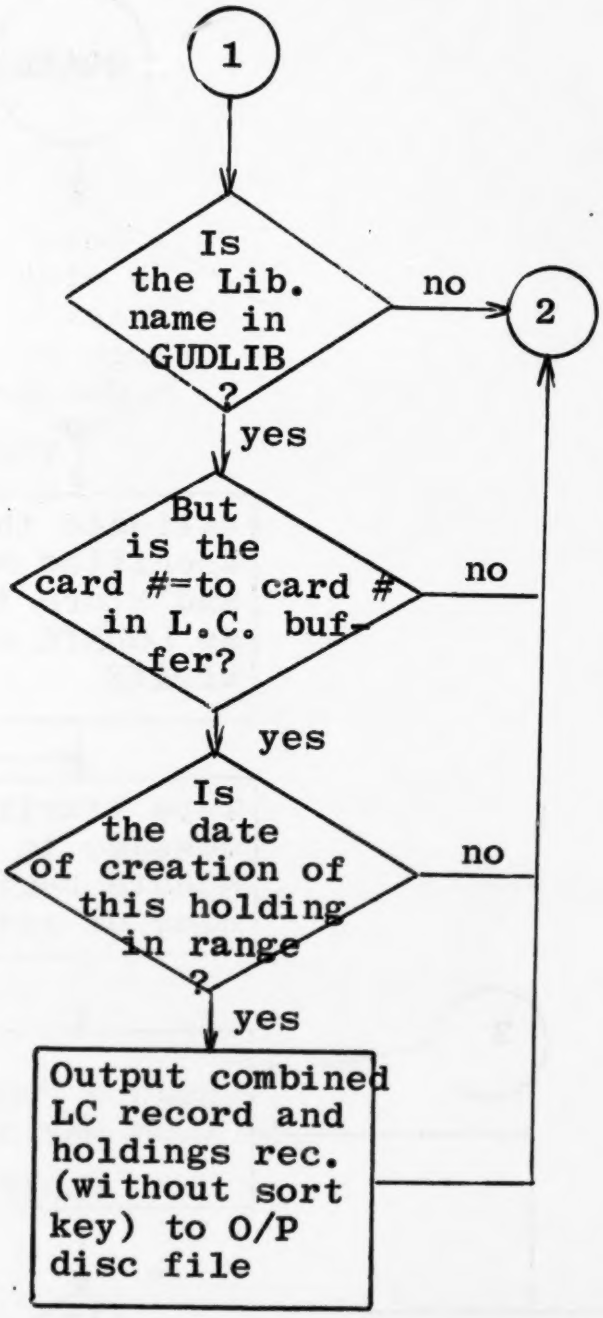
USAGE

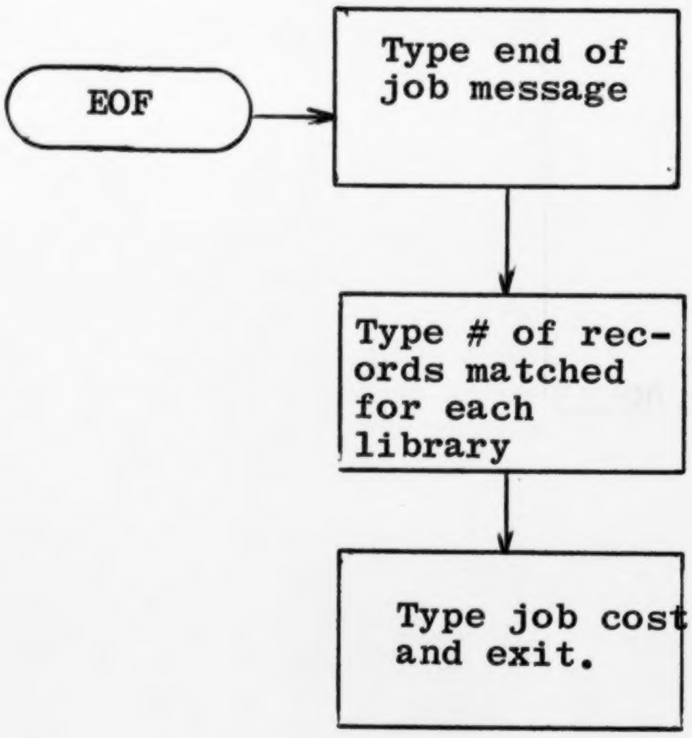
The program begins by asking the operator, "Do you wish to limit the libraries being matched?", to enable production of a UNION LIST representing some subset of the libraries in NELINET. If his response is positive, he will be given the choice of including each library individually. Next, he will be asked if he wishes to specify a range of dates of creation of holdings to be considered valid for the current run. If he replies "yes", the specified range will be used; otherwise, the date of creation of a holding will have no bearing. The program now proceeds to extract holdings and MARC information as specified for further processing into a UNION LIST.

OPERATIONAL FLOWCHART


INITIALIZE
RESET, set up push-down, clear some variables
Does he wish to limit the librar-ies being matched ?
no
yes
Any Libraries remaining ?
no
yes
Store it in GUDLIB
Any libraries remaining ?
no
yes
Does he want to match on it?
no
yes
Store it in GUDLIB table
QDATE


QDATE
Does he wish to specify a range of dates ?
no
yes
Validate the specified dates and store them as LODATE and HIDATE
Set LODATE=0 and HIDATE=7777
Type starting message to denote beginning of action
2
Read a record from Mag tape MAGIP
EOF
Is it an L.C. record ?
yes
Move it to the L.C. buffer as current L.C.
no
Is it a holdings? ("27"=H)
no
yes
1


1
Is the Lib. name in GUDLIB ?
no
2
yes
But is the card #=to card # in L.C. buffer?
no
yes
Is the date of creation of this holding in range ?
no
yes
Output combined LC record and holdings rec. (without sort key) to O/P disc file


EOF
Type end of job message
Type # of records matched for each library
Type job cost and exit.

PROGRAM WRITEUP #10-J-25

TO: PDP-10 Users

FROM: Doug Campbell

SUBJECT: Technical Description - Union List Processor Program (UNLIST) and Device Independent Lister (DEVIL)

DATE: July 29, 1970

REFERENCE: T.M. #381: Holdings File Processing Programs - Functional Specifications

SCOPE

(1) UNLIST takes a standard Inforonics disk Master File produced by the SKEY/SORT programs using HAMR output and extracts, processes and formats the following items:

- (a) L.C. Card Number
- (b) Library Identification Prefix
- (c) Branch Location Symbol
- (d) Call Number

UNLIST outputs a disk Master File containing only the above fields with a one-for-one correspondence in the data portion to the characters it wants output to the line printer. This disc file is the input file to:

(2) DEVIL, a general Master File-to-ASCII subroutine, which sequentially picks up data for all the items in the map, converts to ASCII and outputs to the ASSIGNed device, e.g.:

- (a) Disk (which can be later PRINTed)
- (b) Line Printer
- (c) Teletype
- (d) Mag tape

(3) The UNLIST input file description (Section I.A.) contains the specifications for the Sort Key Generator setup to produce UNLIST's input (using HAMR's output).

TECHNICAL SPECIFICATIONS - UNLIST

I. UNLIST INPUT FILE

A. The Sort Key Generator - SKG - (using HAMR's output as its input) will produce a file for sorting and, in turn, input to UNLIST.

B. Sort Key - six words as follows:

	0	18 35	
Word 0	CRD PREFIX	Y Y 1	Pos. 0-5
Word 1	2 3 4	5 6 *	Pos. 6-11
Word 2	LIBE CODE	CALL	Pos. 12-17
Word 3	NUMBER		Pos. 18-23
Word 4	"		Pos. 24-29
Word 5	BRANCH (LOC. Block 1)		Pos. 30-35

Position	**Tag**	**I/P Item #**	**Description**
0-10	CRD	000100	-1st 11 data chars.
11	---	---	-Always null (00)
12-14	REQ	001101	-1st 3 data chars.
15-29	CAL CALL	012000 013000	-1st 15 chars. of either (left justify, null (00) fill)
30-35	LOC·A	013100	-1st 6 chars. of ·A subfield (see below), left justify, null (00) fill.

C. Data Field Items - All other items are discarded; all output map item numbers = input numbers.

Tag	**Item #**	**Output Description**
CRD	100	-Always (required)
CAL	12000	-Always (optional)
CALL	13000	-Always (optional)
LOC	13100	-Optional. Only output if input includes a ·A subfield, otherwise, discard whole item (see below).

D. Special LOC Statement Processing by the SKG

1. The SKG will have produced a separate input record for each LOC item (13100) found in each input record (from HAMR).

2. The Sort Key, map and data, for each of the multiple records will be the same except for their LOC statement.

3. Each sort key will contain the next sequential LOC statement and only that one LOC item will appear in the map/data portion.

II. UNLIST ITEM PROCESSING

A. L.C. CARD NUMBER (CRD)

1. Words 0 and 1 of the sort key are compared for a change in CRD number.

2. The new CRD item is then picked up from the data portion and is reformated from fixed to variable format to insert the hyphen and suppress leading zeros.

3. After reformatting, it is output to the disc file flush left (i.e., no leading spaces or tabs) as the major sequence item.

B. Library Code (REQ Prefix)

1. Word 2 (left) of the sort key is compared for a change in Library Prefix (within CRD number).

2. There is no REQ item in the map/data. The sort key Library Code, itself, is used to pick up a corresponding output code from a stored table of National Union Catalog standard library abbreviations.

3. This Library Output Code is output with leading spaces/tab to indent it under the CRD number.

C. Call Numbers (CAL and/or CALL)

1. Within CRD number, Word 2 (right) and words 3 and 4 are compared for a change in CAL(L) number.

2. If there is both a MARC CAL and a local CALL, the local was second and over-wrote the MARC in the sort key and the map/data.

3. A new Call Number actually forces the output of the saved previous Call Number and the new one is in turn saved. This means that all branches of a library having the same Call Number will be printed first with their common Call Number indented following the last branch.

D. Branch (LOC·A Symbols)

1. Word 5 of the sort key is compared for different branches of a library (having the same Call Number).

2. Each new branch will be output on a new line indented under its Library Code.

3. If Word 5 of the sort key is zero, there is no LOC symbol and an asterisk (*) is printed next to the Library Code, indicating the following Call Number exists in the main library.

4. If there is more than one ·A subfield in the LOC statement, they are output sequentially on the same line with a space generated to separate each.

5. All subfields in the input LOC statement's data other than the ·A are ignored by UNLIST.

6. Each new branch is printed on a separate line indented under its library code.

III. UNLIST OUTPUT FILE - for input to DEVIL Subroutine

A. There will be no sort key in the output records.

B. There will be one output record written for each input record provided that there is a change in sort keys which warrants that some item(s) need be output.

C. DEVIL Specs for UNLIST Output

(See the DEVIL specs following)
UNLIST/DEVIL will be one combined program.

1. Input Disk File Name = UNLIST.DIC/DAT
2. Output Disk File Name - UNLIST (then listed using PRINT)
3. Sort Key = default = none
4. Map = default = data only

5. Line Length = default = 132 chars. per line
6. End Item = default = CR/LF
7. End Record = Ignore

III. DEVIL KEYBOARD INPUT PARAMETER OPTIONS

A. Input Name - default: none -- user must specify SIXBIT ASCII name on disc input file

B. Output Name - default: DEVIL.LST SIXBIT ASCII name of disc output file (only needed if disc is the output device.)

C. Sort Key - default: assume no sort key

1. "N" words of sort key - do not print.
2. "N" words of sort key - print.

D. Map - default: print data only

1. Print two-column: map then data
2. Print map only - no data
3. If map printing is specified, whether the 18-bit item number be output as 6 octal characters or 3 Master File characters.

E. Line Length - default: 72 if TTY, 132 (or 120) if other characters per line.

The user can specify the maximum number of characters to be printed on a line.

F. End Item (76) and End Record (77) - default: CR/LF for both

The user may choose the character(s) to be output when either an End Item and/or End Record (independently) is encountered. Common options might be:

1. Ignore
2. Return and two line feeds
3. Form Feed

IV. DEVIL PROCESSING OPTIONS

There are no options. DEVIL prints each Master File record completely, sequentially picking up each map word and outputting its data exactly as is.

APPENDIX A

MASTER FILE TO ASCII TABLE

(if ASCII character is blank=same as M/F)

MASTER FILE		7-BIT ASCII	MASTER FILE		7-BIT ASCII
00	★	011 tab	40	–	055
01	1	061	41	J	152/112
02	2	062	42	K	153/113
03	3	063	43	L	154/114
04	4	064	44	M	155/115
05	5	065	45	N	156/116
06	6	066	46	O	157/117
07	7	067	47	P	160/120
10	8	070	50	Q	161/121
11	9	071	51	R	162/122
12	0	060	52	!	041
13	=	075	53	■	134 \
14	,‘	047/042 ' "	54	degree	$
15	:	072	55	][	135/133
16	< >	074/076	56	;	073
17	%	045	57	▲	043 #
20	space	040	60	+	053
21	/	057	61	A	141/101
22	S	163/123	62	B	142/102
23	T	164/124	63	C	143/103
24	U	165/125	64	D	144/104
25	V	166/126	65	E	145/105
26	W	167/127	66	F	146/106
27	X	170/130	67	G	147/107
30	Y	171/131	70	H	150/110
31	Z	172/132	71	I	151/111
32	en-	136 ↑	72	?	077
33	,	054	73	.	056
34	)(	051/050	74	up case	(next char-shift)
35	&	046	75	X times	052 *
36	•	100 @	76	end item	(variable)
37	em-	137 ←	77	end rec.	(variable)